ENGINEERING NEWS.

A bill was introduced in the Senate on July 2, to give to J. K. MCLANAHAN, J. L. MOTT, HENRY FLAD, CHAS. J. CANDA, JAMES ANDREWS, THOS. F. RYAN, GUSTAV LINDENTHAL, WILLIAM F. SHUNK and their associates the authorization of Congress to build and operate a bridge across the Hudson River between the city of New York and the State of New Jersey, for the passage of railroad trains and for other purposes. It is provided that the bridge shall be constructed with a single span over the entire river, of at least 140 ft. in the clear above the level of ordinary high water, and that no piers or other obstructions to navigation, either of a temporary or permanent character, shall be placed or built in the river between the pier lines. All railroad companies desiring to use the bridge shall be entitled to equal rights and privileges on the payment of a reasonable compensation to the owners of the bridge. The bridge is to be built subject to regulations for the security of navigation, to be prescribed by the Secretary of War, and its construction is to be commenced within one and completed within ten years after the approval of the plans for the bridge by the Secretary. The owners of the bridge are required to maintain at their own expense, such lights and signals as the Light-house Board may prescribe.

The bridge proposed is that designed by MR. LINDENTHAL and illustrated and described in these columns last January.

AN underground railway is now "talked of" for Chicago since the failure of the elevated projects to materialize, and the Chicago Tunnel Railway Co. has been incorporated. The most active promoter of the scheme is Mr. GEORGE W. WAITE of Hyde Park, and associated with him are WESLEY R. CRUMPTON, FRANK MCMASTER, L. H. CLARK, T. M. NELSON, and others. It is estimated that the total cost of construction will be $27,000,000, which is at the rate of $1,000,000 per mile, which is about half the cost of the London work, but, perhaps not impossibly low. The plan proposed is generally similar to the Metropolitan Railway of London, but the most objectionable features of the London system, the smoke and darkness, is to be obviated by the use of electricity as a motive power and for lighting. Passenger elevators, capable of carrying from 50 to 100 persons, are to be placed at every station, to remove another disadvantage of the London system, the stairways. Soft lime-stone is supposed to exist at a depth of 100 ft. or 150 ft., and this makes excellent road-bed and can be easily and cheaply tunneled, so that the engineering difficulties to be overcome seem to be comparatively inconsiderable. If quicksand pockets, like those which gave so much trouble in the Lake tunnel, are encountered, it is proposed to resort to an iron tubular tunnel.

AT a recent meeting of representatives of roads running Wagner cars a vote was taken to decide what system of steam coupling shall be adopted to assure uniformity. The Martin system received a majority of 26 votes over the Sewell system. This action is not binding, however, unless approved by the executive officers of the road. Representatives of the New York Central, West Shore, Michigan Central, Lake Shore, Boston & Albany, Rome, Watertown & Ogdensburg, and Cleveland, Columbus, Cincinnati & Indianapolis, voted in favor of the Martin system.

RAILROAD COMMISSIONER SWIFT, of Illinois, is making an earnest effort to have grade crossings "properly protected" in Chicago, by which is meant not over or under crossings but simply gates and flagmen. According to a list furnished by Mr. SWIFT there is the following appalling list of crossings which have not even this poor protection within the city limits of Chicago.

Illinois Central	2
Atchison, Topeka & Santa Fé	3
Chicago & Western Indiana	4
Chicago, Rock Island & Pacific Ry	10
Wisconsin Central	9
Chicago, Alton & St. Louis	6
Pittsburg, Fort Wayne & Chicago	4
Chicago, Burlington & Quincy	22
Chicago, St. Louis & Pittsburg	24
Chicago, Milwaukee & St. Paul	18
Chicago & Northwestern	29
Total	131

The list shows a barbarous state of things in Chicago, which ought to have ended long since.

IN a recent trial, at Lake View, Ill., a car equipped with a motor using compressed air made a round trip in 35 minutes for which the usual horse-car time is 75 minutes. The system is used quite extensively abroad and was brought here from Berlin by a company which owns the right for the United States.

NO very serious railway accidents have been reported since the wreck of the "Cannon Ball" mail train, June 27, at Hurricane Bayou, 16 miles north of Mobile, Ala., on the Louisville & Nashville Railroad, which was noted in our issue of June 30. The cause of the accident was the undermining by heavy rains, of a small culvert. The locomotive left the track and turned over, killing both engineer and firemen, and six of the eight cars in the train followed it.——A freight train on the Grand Trunk Railway was wrecked near Valparaiso, Ind. June 30. The cause of the accident was the striking of some horses on the track. The brakemen was killed and the firemen severely injured.——A peculiar accident occurred on the Rome, Watertown & Ogdensberg Railway at Newfane Station. The train parted while crossing a bridge, and a passenger fell through and was killed.

THE Mexican freight depot and adjoining buildings at Paso Del Norte, were destroyed by fire June 27. Loss estimated at $200,000.——A trestle on the West Shore Railroad, near Highland, N. Y., caught fire June 27, but the flames were extinguished before much damage was done.

THE tremendous rainfall of 10¾ ins. is reported from Mobile, Ala., during the 36 hours ending on the night of Tuesday, June 26. The *Philadelphia Ledger* recalls as an offset a 12 in. rainfall in Nevada Co., Cal., within 48 hours, ending Jan. 11, 1862, and adds: "In that same winter of 1862, and in that same county of Nevada, the rainfall for the month, between December 23, 1861, and January 23, 1862—thirty-one days—was 45 inches—3 ft. 9 in!"

WASHOUTS have occurred during the week in Illinois, in Henderson and other counties.——In New Orleans, La., three bridges over the Claiborne canal were swept away by the high water.

THE C., B. & Q. is gradually taking out all the small bridges and culverts along its line, substituting in their place large iron pipe, over which is constructed a solid road bed.

THE Spanish Government has authorized the construction of two new railways on the isle of Luzon, one of the Philippines. One line will extend from Manilla to Antipolo, 18 miles, furnishing an outlet for the sugar and hemp produced, and making more accessible some fine mountain scenery. The second road is to connect Manilla with Dagupan, another seaport 120 miles away. Both lines are to be built with British capital, though the second, after 99 years during which Spain guarantees eight per cent. on capital invested, becomes the property of the Spanish Government without compensation.

THE amendments to the Inter-State Commerce Law now before Congress are numerous. One is to require a three days' notice of the reduction of rates. Another proposes to extend the penalty for unlawful discrimination to imprisonment as well as to fines. Another is directed against the practice known as "underbilling," by which goods that should come under one classification were entered under a lower classification. The other amendments are for the most part formal.

THE Naval Appropriation Bill, which recently passed the House, provides for three additional men of war. Two of them are to be unarmored steel cruisers of about 3,000 tons displacement, and the third is to be an armored steel cruiser of about 5,300 tons displacement. The first two are to cost, exclusive of armament, not more than $1,800,000, and the third is to cost also exclusive of armament, not more than $3,500,000. The two unarmored vessels are to have a maximum speed of at least nineteen knots an hour, and the armored cruiser is to have a speed of not less than twenty knots an hour. At least one of the vessels is to be built in one of the navy yards of the United States. If contracts at reasonable prices can not be made for building the other vessels, they will also be built at one of the U. S. navy yards.

IMMIGRATION statistics for the month of May shows, that the business of this country is in good condition, and that there is no immediate prospect of a collapse. The following table shows the increase this year over corresponding periods in 1887.

	1888.	1887.	Increase.
Month ending May 31.	98,439	85,664	12,775
Five Mo. ending May 31.	247,736	221,066	26,670
Eleven Mo. ending May 31.	471,343	417,732	53,611

The countries which have made the greatest contributions to this marked increase are Russia, Italy and Austro-Hungary.

RUSSIAN petroleum has taken possession of the European markets to an extent which has materially reduced the exports of this illuminant from the United States. The exports during the past year have already fallen off about 15 per cent. If it were not that the Russian is decidedly inferior in quality to the American article, its introduction and the displacement of the American product would be still more complete.

IN Carlisle, Eng., tall factory chimneys are being utilized as sewer ventilators with good results, 29 now being used. The velocity of the rising air has been measured by surveyor MEKIE and it is found to be 1,302 ft. a minute in ordinary weather. The owners of the factories make no objection to this use of their chimneys, and the practice seems to meet with general approval.

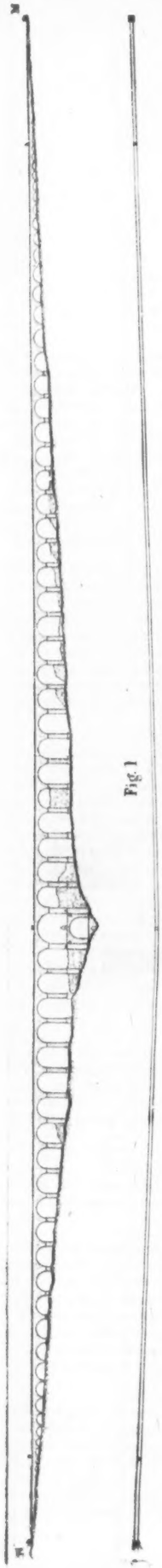


Fig. 1

Zempoala Aqueduct.—General Elevation and Plan.

(The obstructions between some of the piers are the remnants of the old *adobe* (large sun-baked clay bricks) centerings, which were evidently not entirely removed and have remained intact for over three centuries. Adobe is generally used for centering in Mexico in place of timber, which is scarce and high. It is also the universal building material for the poorer class of houses, and largely used for buildings of no little pretension, being stuccoed over on the front for appearance sake, and to protect it from ruin. Even without such protection the above will show that it is very durable.

Figs. 1 to 4 are direct reproductions from old drawings, and hence are somewhat crude. The scale does not precisely agree with the figured dimensions, as given herewith.]

The Aqueduct of Zempoala, Mexico.

Among the most interesting engineering monuments of Mexico, dating back to within a few years of the Spanish Conquest, is the work which we illustrate.

It is with justice considered something of a marvel, considering its date. It is situated in the State of Hidalgo, the District of Apan, and its engineer and designer was Friar FRANCISCO TEMBLEQUE, a Franciscan monk. It served for probably two centuries to carry water to the city of Otumba; but before describing the work itself, we may add certain historical notes, relating to the period of its construction.

The Spaniards having conquered Mexico, the first tendency was almost wholly destructive; but it was not long before many individuals at least, of nobler minds and more lofty ideas, began to compensate for these evils, by various benefactions tending to better the condition of the conquered, and give them some benefit, at least, from Spanish civilization. Among these early benefactors the priest engineer who designed and built the work which we illustrate, certainly deserves high rank.

The city of Otumba, standing on elevated ground, is inaccessible to water from surrounding hills by direct flow, and hence the town was able to supply itself only by rain water collected in cisterns, which, by the end of the dry season became a scant and poor supply. The evil would have been less important if Otumba had not been a necessary point in the journey from Mexico to Vera Cruz, and the constantly passing caravans, not only exhausted the supply, but made it muddy and foul.

The monk mentioned seems to have taken hold of the project of supplying the city with better water in the true spirit of philanthrophy, and devised a plan for bringing water from the mountain Lecajete, 26½ miles off.

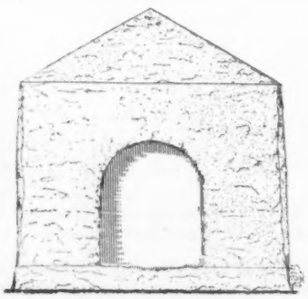
To this end, in February, 1553, (the conquest was completed in 1521-5), there was signed a curious contract between the town of Otumba and Zempoala, under the conditions of which the first was to supply priests and friars to minister to the spiritual needs of the second, which in return was to give the water and aid with labor and material in the construction of the aqueduct, which was to carry water to the first city. This contract was a highly religious one, as may be seen from the document which follows, which we fully translate in somewhat abbreviated form. It still exists in Mexico, but has never seen the light of print in English before to our knowledge.

"I, Friar CRISTOBAL YCHANRIGUI, preacher and secretary of this holy province of the holy evangel, certify that Father LUIS GARRO, preacher and guardian of the Convent of All Saints, Zempoala, has presented to me a patent in favor of the natives of said town, whose literal tenor is as follows:

"We, Friar JUAN DE BUSTAMANTE, Commissioner General of the Indies of the ocean seas, and Friar JUAN DE SAN FRANCISCO, Provincial Master of the province of said holy evangel, and Friar DIEGO NOLUARTE, and Friar JUAN DE GAONA, and Friar ANTONIO CINDAD RODRIQUEZ, and Friar BERNARDINO DE SAHAGUN, subordinate priests of said provincie of the holy evangel, declare:

"That inasmuch as you, the Governor alcaldes and principal officers of the town of Zacoala, have agreed, for the love of God and because of our intercession with the same officers of the town of Otumba to give to them half the water which you have in your town of Zacoala for the use and benefit of the inhabitants of Otumba and for the use of the monastery of our order founded in that town, in which you do great good to them and to our said monastery, because of our intercession as stated; and inasmuch, moreover, as you the said people of Zacoala, with much labor and for the good of your souls, agree to join with the people of Flaquilpam and Zempoala in the place where you are erecting an 'All Saints' monastery, at which point you agree to remain and work, and not to depart for the reason that you are removed from your own houses; in order to labor for the good of other souls, and in return for the labor which the priests have in visiting you. And whereas now you will soon have together a monastery for the friars of our order, in which must be administered for all the Holy Sacraments; therefore, in return for this benefit and work, we promise you that in all our time we will not cease to give friars for said monastery, and that for the whole length of our lives we will aid in your prayers in all the agreed respects; and for the time to come after our lives, in consideration of said benefit, we will petition the Commissioners General and Provincial Masters that they will severally and collectively adhere to the agreement, and always have the charity to furnish friars in the Monastery of All Saints, as now, in view of the great and good work which you have done through our intercession, both in giving the said water, and in aiding the works to supply it. And if by chance there should happen to be so few priests that it is impossible to spare them from the house of Otumba that they shall place friars in said Monastery of All Saints first, and let the loss fall upon other places than Zocoala and the Monastery of 'All Saints', in all of which places you are entitled to be taught by our priests. We will beg of our successors in charity to favor us in these said respects, in return for your faithful labors and agreements in our behalf, and so we sign this agreement, made this seventh day of February, 1553." Then follow the signatures.

Fig. 2



Entrance Arch way at each end of Aqueduct. Side View. Scale $\frac{1}{50}$, 5ft., per in.
[The recess is for a shrine, not for the passage of water.]

Fig. 3

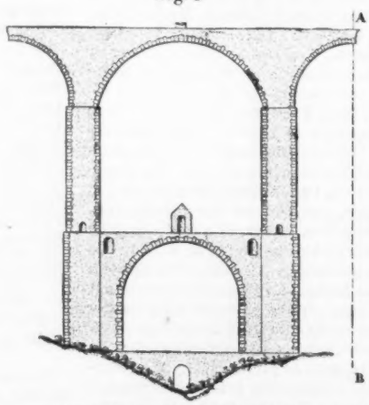
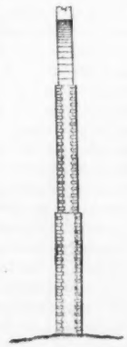


Fig. 4



Elevation and Section of Central Arch. Scale, $\frac{1}{100}$, 50 ft. per in.
[The recesses in the elevation, and the small central structures are for shrines.]

The Zempoala Aqueduct.—FRIAR FRANCISCO TEMBLEQUE, Engineer, 1553-1570.

This unique contract for an exchange of benefits being formulated and agreed on, the construction of the aqueduct was soon begun; it is not known precisely at what time, but it is made almost certain that it was in the same year 1553, by some facts to be given below.

The broad minded friar began his work "with more boldness than knowledge", according to some of his contemporaries. It is now clear that he had both, but he met the usual opposition from the narrow-minded and jealous. The wise ones among both the clergy and (laity) said it was apparent that the water would be taken from a lower point than it would be carried to, and that the undertaking was too costly and rash to succeed. This claim led some of the authorities to interfere by sending a secret envoy to an "Alcalde" in still higher authority and the legend as to the final outcome is thus quaintly recorded in the ancient history (BETAUCOURT *Teatro Mexicano*) to which the world is indebted for the preservation of much curious information as to this and many other facts in the early history of Mexico.

"The Friar TEMBLEQUE lived in a hermitage close to the arches in course of construction, where he was ministering to the spiritual needs of the Indians who worked for him. He had for his sole companion a grey cat, which brought him every day a rabbit in the rabbit season, and a quail in the quail season. Doubting that this work, so grand and massive, would be able to accomplish the desired result, the "Alcalde" made him a visit at the moment when the cat was entering with a rabbit; when Friar TEMBLEQUE told him (the cat) to bring another for the visitor. The cat started out at once for it, and when he brought it the "Alcalde" was forthwith convinced that the work was in good hands, and would have good results."

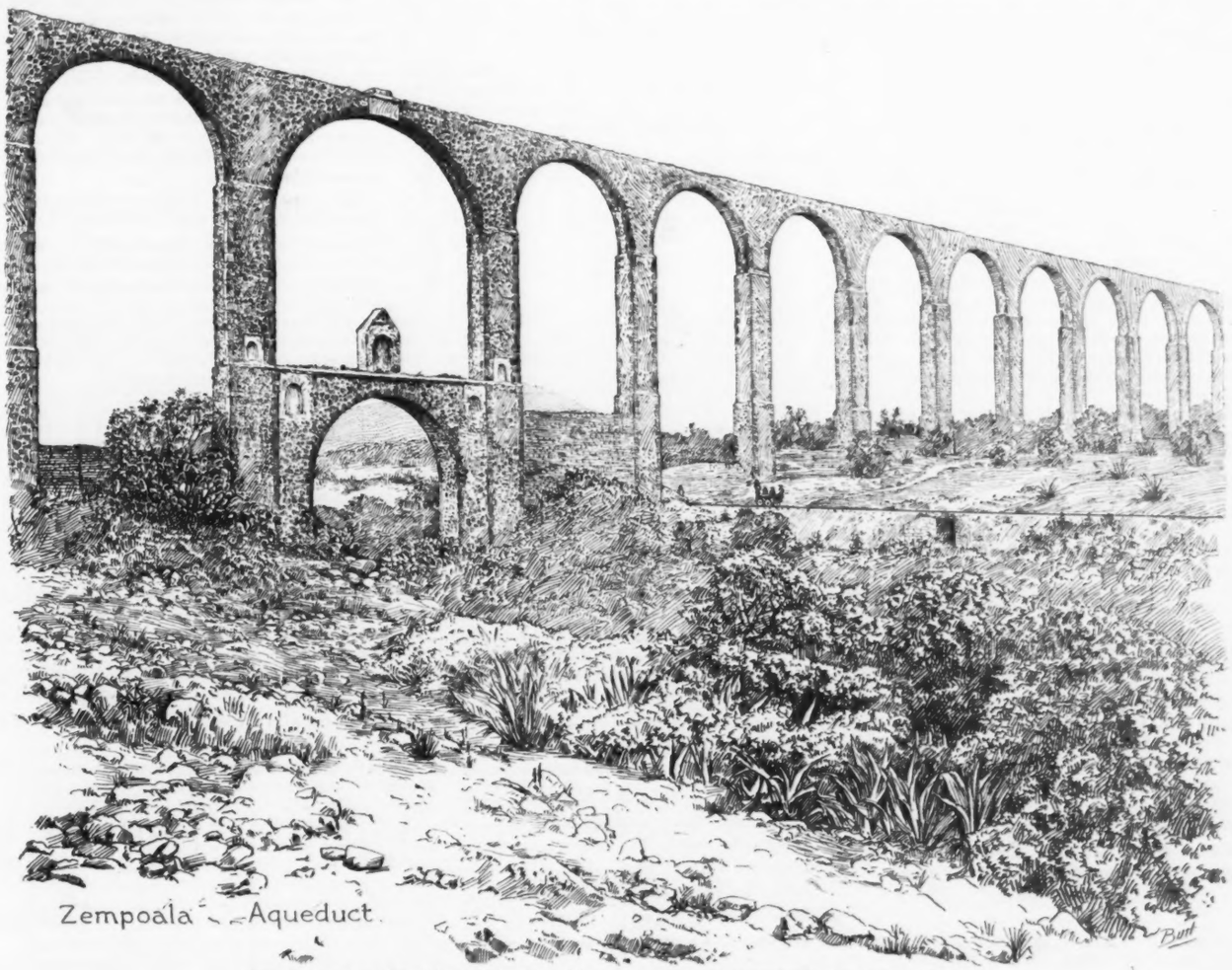
The "office cat" of the New York *Sun* was not so

sagacious an animal as this; and many an engineer would be glad to have a similar cat about his office to convince doubting Thomases. As was natural the "Alcalde's" verdict silenced all murmurers who began only to admire the grandeur and boldness of the work, and the persistence of TEMBLEQUE in seeking his end; and to declare that, although he had no real skill in such work he would yet complete it by divine aid. And to day, if we take into account the state of knowledge among the followers

At each end of the aqueduct are two masonry archways, whose elevations are similar to Fig. 2, following in this the usual Spanish custom of dignifying somewhat such approaches, even when no utilitarian end is subserved. We are so highly civilized in this age and country that we rarely indulge in such foolishness.

The number of arches is 68, the highest of which is 32 .34 metres (109 ft.) up to the springing line. The span of this notable arch, is 15.97 metres (56 ft.) and

gins to fail somewhat, besides which individuals have begun to use it as a quarry to some extent, the usual sad fate of such relics of the past. A little care would preserve it indefinitely, and there is still enough population at Otumba to justify its maintenance; and there is a feeling among many of the neighboring villages as well as with the local and national authorities which may result in the renewed use of the work as an aqueduct, it being still in all parts in almost perfect condition.



The Zempoala Aqueduct, Mexico. FRIAR FRANCISCO TEMBLEQUE, Engineer, 1553-1570.
(The Hidalgo Railway now runs as shown underneath the structure.)

of CORTEZ, we may well pay the homage of respect and admiration to this humble missionary, who knew so well what he was about, and was not to be cajoled or frightened from doing it.

The water conduit has in all a length of 160,496 Spanish feet, or 44.832 kilos. Three masonry aqueducts were constructed, at three different points; the first of 46 arches, the second of 13 arches and the third of 68, which latter is the one we illustrate, and the most notable feature of the work. The main body of the aqueduct we shall not attempt to describe in detail.

The especial part of this ancient work which we illustrate is to-day, it is almost certain, at least 316 years old. Its length is 902.71 metres, (about 3,000 ft.) its altitude above the bottom of the valley is 37.8 metres, (124 ft.) and its elevation above the sea, 2400.83 metres, (7,677 ft.). Its direction is from northwest to southwest, it not being a straight line, but two straight parts, which form an angle with each other of about 177° at the highest arch, as shown in Fig 1. As in many of these ancient Spanish works, the section of the water channel is very small in proportion to the size of the structure, which carries it. In this work, it is almost exactly 8½ by 12 ins. with a very slight grade, sufficient to give a rather rapid current to the water, which, we may add, is nearly uniform throughout the canal, showing that it was very skillfully laid out.

it is shown to a larger scale in Fig. 3, in which can be seen in detail the different parts of which it is made up. The little recesses are for Saints' images. The lowest arch in Fig. 1 gave passage for the water, which commonly runs in the small channel. It has, however, been recently removed, and does not appear in our general view, taken from a recent photograph. The remains of the *adobe* centerings are still standing between some of the piers, as shown in the general view, Fig. 1, and also in Fig. 5. We may here note that *adobe* makes a first class centering, and a far cheaper one than timber in this almost treeless country. The larger sub-archway above, capped by a Saint's shrine, which still remains, appears to have had for its object to stiffen the piers against the lateral thrust due to the angle in the plan and to provide for any attacks of the water on the foundations: and if so, shows considerable intuitive comprehension of engineering principles. They have also been supposed, however, to be a subsequent addition.

Fig. 4 shows a section on the line *A B*, Fig. 3. As will be seen, the thickness of the arch at the crown is very small, 1.5 metres high and 1.42 metres wide over all (4 ft. 11 ins. × 4 ft. 8 ins.) including the side walls for the water channel.

The aqueduct is now abandoned for lack of sufficient population and enterprise to keep it up; and for lack of ordinary care of maintenance it now be-

The construction of the work lasted for 16 or 17 years, of which about 5 were occupied in building the principal aqueduct illustrated. To indicate the precise date of the construction, RETANCOURT published his *Teatro Mexicano* in 1698, it is believed that he finished writing the work in 1695, and he states that at this date the Aqueduct of Otumba had been constructed more than 140 years, and was in perfect condition, from which it follows that it was begun in 1554 and completed in 1571. In the hardly admissible supposition that the Zempoala Aqueduct was built toward the end of the work, we have as its present age 317 years.

TORQUEMADA was authorized to publish his *Indian Monarchy* at the end of 1613; and stated that at that time the great work of TEMBLEQUE was 60 years old, which gives the date of the beginning of the Aqueduct the year 1553, and also indicates a minimum age of the Aqueduct of 316 or 317 years.

It is to be remembered also, that the contract between Otumba and Zempoala was definitely sanctioned in Texcoco in 1553, a date which coincides for the beginning of the work with those above.

It is on record that in 1694 the water supply to Otumba failed, although the cause is not recorded, except that the supply was renewed by the Alcalde Don JUAN CABALLERO in the following year. The chronicler does not state how CABALLERO was rewarded for his labors, but it does state that he at

tributed his success to the miraculous aid of Saint Nicholas.

The Friar TEMBLEQUE well deserves that more note should be made of the facts of his life, than is here possible. He survived many years after the conclusion of his work, being an important official of the Franciscan monks at Puebla, and at last returned to his original convent of Zempoala, becoming blind and very infirm before his death at a great age.

The aqueduct continued to deliver water to Otumba for 123 years beyond doubt. It was then interrupted and renewed the next year, and precisely how long it continued thereafter to deliver water before its use was finally interrupted, and why it was so interrupted, is now unknown. It is hardly supposible that it was merely some slight break in the conduit, which led the inhabitants to give up their time honored source of supply, which in all its main parts is still wholly intact, as the view shows, but tradition does not record any specific cause, and it is suspected that the numerous earthquakes to which this region is subject, or some other natural cause may have lessened the source of water supply, relatively to the other terminus, but this has not been investigated by precise leveling, as it may soon be, and certainly ought to be. An exact profile, showing how nearly this self taught engineer reached a true grade without instruments of precision, would be of great interest, apart from the question as to cause of abandonment.

Be this as it may, it is certainly appropriate to call particular attention to the fact, that this Aqueduct is in an earthquake country, is very high and very slender, and yet it does not appear to have been injured at all, beyond some probable cracks, which have been closed, by any of the earthquakes to which it has been exposed. This fact certainly tends to support the claim made on behalf of the Nicaragua Canal enterprise, that although that is admittedly an earthquake country, yet like all Central America, that these earthquakes do not seem to injure engineering works for the impounding of water or even high structures for its conveyance. The structure we illustrate has unquestionably been subjected to many severe earthquakes.

It is estimated that a sum of $10,000 to $15,000 would suffice to completely reconstruct the defective parts of this grand work of the Friar TEMBLEQUE if the relative levels have not been disturbed, and there is some likelihood of its being done.

Papers Read at the Annual Convention of the American Society of Civil Engineers.

Head in Feet Necessary to Obtain Different Velocities in Pipes of Given Diameters.

[Abstract of paper by CHAS. B. BRUSH.]

On Nov. 15, 1881, the City of Hoboken contracted with the Hackensack Water Company, re-organized, for a new water supply. The plant was ready Nov. 1, 1882, and since that time it has been in operation. This plant supplied Hoboken, an old unmetered district, for about one year, but after that time it has in addition furnished water to new districts, which never before had a public supply, and, in which every service pipe is metered. Since 1882 the total of the population supplied in all the districts has been increased from 33,000 to 75,000—the total taps from 2,700 to 5,600—the total meters from 47 to 2,607—the total length of cast-iron main from 16 to 77 miles—while the total amount of water pumped has only increased from 4,000,000 to 4,250,000 U. S. galls. per day.

For five years the water was pumped to a reservoir through a single line of 20-in. cast-iron pipe, 75,000 ft. long, under a static head of 165 ft. The main is laid along railroads and highways with a large number of summits, angles and curves. No special attempt was made to obtain true lines and grades. The exigencies of a public water supply have naturally produced irregularities in our results, but no attempt has been made to harmonize apparent incongruities. The average delivery has been about 4,000,000 galls. per day, but the meter records show that of this amount about 200,000 galls. per day are taken from the main before the balance of the water reaches the reservoir; 100,000 galls. being taken at a point about 13,500 ft. from the pumping station and the remaining 100,000 galls. is taken at a point about 70,000 ft. from the station. This 200,000 galls. is not leakage; it is water delivered to consumers located at about these points. The main is laid partly in sandy soil, partly through rock cut, and the balance through soft marsh lands. It crosses numerous culverts and small streams, beside passing under two rivers 400 ft. wide and from 15 to 25 ft. deep. The elevation of the main above mean high tide for the first 34,000 ft. is from 2 to 18 ft.—at 37,000 ft. from the pumping station its elevation is 35 ft.—between 36,000 and 48,000 ft. from said station the elevation is from 3 to 6 ft. and for the balance of the line the following are the principal elevations.

At 50,000 ft.	from the pum'pg station	the elevation is	46 ft.
" 52,000	" "	"	13 "
" 53,000	" "	"	28 "
" 55,000	" "	"	20 "
" 60,000	" "	"	74 "
" 64,500	" "	"	8 "
" 66,000	" "	"	29 "
At 69,500 ft.	from the pum'pg station	the elevation is	17 ft.
" 71,000	" "	"	166 "
" 71,800	" "	"	157 "
" 73,000	" "	"	172 "
" 74,000	" "	"	148 "
" 75,000	" "	"	180 "

RESULTS OBTAINED BY THE HACKENSACK WATER COMPANY, REORGANIZED, FROM 1882-1887 IN PUMPING WATER THROUGH A 20-IN. CAST-IRON MAIN, 75,000 FEET LONG, UNDER CONDITIONS ABOVE STATED. ALSO RESULTS WITH SAME DATA OBTAINED FROM STANDARD FORMULAS, AS TO FRICTION, VELOCITY AND DISCHARGE.

Table No. 1, showing actual results obtained by the Hackensack Water Co., Reorganized.

Pressure in lbs. per sq. in. at pumping station	95	100	105	110	115	120	125	130
Total effective head in feet	55	66	77	89	100	112	123	135
Discharge in U. S. gallons in 24 hours, 1 = 1,000	2 848	3,165	3,354	3,566	3,804	3,904	4,116	4,255
Actual velocity in main in feet per second	2·00	2·24	2·36	2·52	2·68	2·76	2·92	3·00
Cost of coal consumed in delivering each million U. S. gallons at given velocities	$8.40	$8.15	$8.00	$8.10	$8.30	$8.60	$9.00	$9.60

Table No. 2, showing actual and theoretical friction heads per 1,000 ft. at velocities given in Table No. 1, ranging from 2 to 3 ft. per second.

Hackensack Water Co., Reorganized	0·729	0·876	1·029	1·316	1.337	1.490	1.645	1·797
D'Arcy. $h = .020889 \frac{lv^2}{2dg}$	0·779	0·977	1.083	1·236	1·397	1.482	1·659	1.752
Weisbach. $h = \left\{ 0.1439 + \frac{.017155}{\sqrt{v}} \right\} \frac{lv^2}{2dg}$	0·998	1·222	1·343	1.505	1·680	1.772	1.963	2·061
Tables published by the Cinn. & Newport Pipe Co.	0·928	1·146	1.266	1·438	1·615	1.705	1.904	2·008
Prony. $v = 97.05\ (rs)^{\frac{1}{2}}$	1·136	1·371	1·516	1.722	1.940	2.055	2.293	2.417
Kirkwood. $h = \frac{v^2 l}{1600d}$ For tuberculated pipe.	1.499	1.880	2·088	2·380	2.692	2.856	3·196	3·374

Table No. 3, showing actual and theoretical velocities in feet per second due to heads given in Table No. 1, ranging from 55 to 135 ft.

Hackensack Water Co., Reorganized	2·00	2·24	2·36	2·52	2·68	2·76	2·92	3·00
Lampe. $v = 203.3\ r^{.666}\ s^{.518}$	2·015	2·231	2 429	2·632	2.809	2.980	3.151	3·318
D'Arcy. $v = 111.00\ (rs)^{\frac{1}{2}}$	1·941	2·125	2·295	2·468	2 617	2.770	2.902	3.040
Chezy. $v = 100\ c\ (rs)^{\frac{1}{2}}$								
Leslie. $v = 100\ (rs)^{\frac{1}{2}}$	1·747	1·914	2·067	2·201	2·356	2.494	2.648	2.736
Beardmore. $v = 50\left(\frac{hd}{l}\right)^{\frac{1}{2}}$								
Prony. $v = 97.05\ (rs)^{\frac{1}{2}}$	1·695	1.857	2·006	2 146	2.286	2.425	2.569	2.655
Eytelwein. $v = 47.8\left(\frac{hd}{l + 54\ d}\right)^{\frac{1}{2}}$	1.672	1·832	1·978	2·127	2·255	2.386	2.501	2.620
D'Aubuisson. $v = 95.6\ (rs)^{\frac{1}{2}}$	1.670	1·839	1·976	2 104	2·252	2·384	2.531	2.616
Blackwell. $v = 95.8\ (r\ s)^{\frac{1}{2}}$ Accounting for curves.	1·674	1·834	1 980	2·109	2·257	2.389	2.537	2·621

Table No. 4, showing actual and theoretical discharge, in thousands of U. S. galls., in 24 hours due to heads given in Tabl No. 1, ranging from 55 to 135 ft. (Hundreds omitted).

Hackensack Water Co., Reorganized	2 848	3,165	3,354	3,566	3 804	3,904	4,116	4,255
Lampe	2.848	3,153	3,433	3,720	3,971	4,212	4,454	4.690
D'Arcy	2,743	3,004	3,244	3,488	3,699	3 915	4,102	4,297
Chezy, Leslie, Beardmore	2,469	2,705	2.922	3,111	3,330	3,525	3,743	3,867
Prony	2 396	2,624	2,835	3,033	3,230	3,427	3,659	3,745
Eytelwein	2,363	2,589	2,796	3 006	3,187	3,373	3,535	3,703
D'Aubuisson	2,360	2,599	2,793	2.974	3,183	3,370	3,578	3,698
Blackwell	2,366	2,592	2,799	2,981	3,190	3,377	3,586	3,705

Note. h = Head in feet. v = Velocity in feet per second. r = Hydraulic mean radius. s = Sine of the inclination. l = Length in feet. d = Diameter in feet. g = 32.2.

D'Arcy's formula, given above, is special for 20-in. pipe See Paper of Mr. ELLIS, read before the American Water Works Association May 16, 1883.

Among the horizontal bends in the pipe there may be mentioned 4 right angles and 10 quadrants of about 30 feet radius.

The friction head on this main has been found to be considerably less than most of the formulas of standard authorities would indicate.

For the purpose of comparison I have tabulated, after allowing 5 per cent. for slip of pumps, the results actually obtained and those obtained from given formulas, using the same data as to head, length and diameter in each case.

This table indicates that the amount of water that can be most economically delivered through a 20 in. main under a static head of 165 ft. is about 3,350,000 gall. per day; a delivery which necessitates a velocity of 2.36 ft. per sec. and develops a friction head of .029 per 1,000 or 5.43 ft. per mile. Under these conditions, the cost of the coal consumed was $8 per million gallons pumped.

With the same pumps (two compound condensing duplex low duty three million gallons Worthington engines) it cost $8.40 and $9.60 per millon gallons to pump respectively 2,848,000 and 4,255,300 gallons per day, through the same main.

The increased cost on the lower velocities was probably due to the fact that the plant could not be operated to its greatest efficiency. The increased cost on the higher velocities was probably due to increased friction.

The formulas which agree best with the results we have obtained are those of LAMPE and D'ARCY.

LAMPE'S experiment (Danzig, 1869-71) were made with a 16-in. main on a length of 38,000 ft.

D'ARCY'S experiments (Paris, 1849-51) were made with pipes 367 ft. long, the largest diameter used being 20 ins.

Nearly all of the other formulas are based on experiments made on pipes of short lengths and comparatively small diameters. The earliest of the formulas given is that of CHEZY in 1775. His form, given above, has been followed by most of the later authorities except Weisbach; the principal difference being in their substitution of different con-

stants depending upon the diameter and inclination. Weisbach's constants depend not only upon these, but also upon the velocity. The formulas of CHEZY, LESLIE and BEARDMORE are practically the same. The formulas of PRONY, EYTELWEIN, D'AUBUISSON and BLACKWELL agree very closely with each other.

For further particulars see "Hydraulics," by HAMILTON SMITH, Jr., M. Am., Soc. C. E., 1886.

The mains upon which Lampe and D'Arcy made their experiments were laid with extraordinary care and a with view to these experiments.

Our actual results given in the above tables are especially interesting in view of the fact that only ordinary precautions were taken and no attempt was made to avoid angles, high intermediate summits and numerous sharp curves.

[The paper was followed by some interesting notes as to waste and loss from mains, which we shall abstract later. —ED.]

English Railroad Track.

[Abstract of paper by E. E. RUSSELL TRATMAN].

The standard type of English track consists of heavy rails carried in cast-iron chairs which are attached to timber cross-ties. The rails are of two sections, "double-headed" and "bull-headed"; the former section has two heads of similar form, connected by a web, and is intended to be reversible, although the reversing is very rarely carried out now; the latter section is simply a non-reversible, double-headed rail, the disadvantages of reversing being recognized and the lower head made only large enough to give a hold to the wooden key or wedge which secures the rail in the chair. Flange (or Vignoles) rails are very little used on English roads and they are apparently being used less and less; lines which formerly had this style of rail being relaid with the "bull-headed" rail, which is now the standard English rail section.

Answers to inquiries were almost invariably unfavorable to the flange rail. The engineer of the Midland Railway wrote that he thought the breakages of rails in America were the result of a defective design, and that in his opinion, a flange rail track would not stand the great velocities and the heavy weights on the driving wheels of the Midland engines. This, of course, is mainly a matter of prejudice, as the flange rail is used successfully for very heavy traffic; and, in fact, this section, as a type, is the standard section of the world, the double-headed rails being used mainly in the United Kingdom and to a small extent on the European continent, and in India and the English colonies.

The Chief Engineer of the Great Northern Railway of Ireland, on which both bull-headed and flange rails are used, wrote that the former are used for divisions on which heavy curves and grades exist, this section of rail being more easily bent and retaining the curve better than the flange rails. He estimated the comparative cost as three to four—the flange rail track being the cheaper.

The Chief Engineer of the Severn and Wrye and Severn Bridge Railway wrote that his experience with the flange rail was unfavorable on a line with heavy curves and grades, operated by 50-ton tank engines, the trouble being with the maintenance of the track. The greater part of the line was, therefore, relaid with double-headed rails.

The Chief Engineer of the Midland Great Western Railway of Ireland, however, wrote in favor of the flange rail, stating that it was generally adopted in Ireland, and that general opinion was in favor of it as being "cheaper and nearly as steady as the double head or bull-head." Other Irish Engineers speak in favor of the flange rail, but always with a reservation. The explanation to this appears to be, according to the writer's opinion, the rigid wheel base of the majority of the locomotives and cars.

The English track is substantial and safe, but it is unreasonably and unnecessarily heavy and expensive, which facts render it especially undesirable for the colonies and new countries. But before going further into a comparison of the respective merits of the types of track, it may be well to describe the tracks of some English railroads.

GREAT NORTHERN RAILWAY.

The standard track consists of Bessemer steel rails of bull-headed section, 30 ft. long, weighing 82 lbs per yd. They are supported in cast-iron chairs on each sleeper; the chairs having a base of 6¼ ins. × 15½ ins., and the joint chairs a base of 8 ins. × 15½ ins. The rails have an inward cant of 1 in 24. The ties are of creosoted Baltic redwood timber, 8 ft. 11 ins. long, and are spaced 2 ft. 7⅝ ins., center to center, and 1 ft. 9¼ ins. at the joints. The rails are secured in the chairs by keys of compressed fir driven between the web of the rail and the jaw of the chair; these keys are placed on the outside of the track. The chairs are attached to the ties by round spikes and treenails. The rail joints are even, and are spliced with two plain, straight fish-plates, 18 ins. long, with four ¾-in. bolts; the two outer bolts pass through the fish-plates and rail in the usual way, but the two bolts next the rail ends pass also through the jaw of the chair, which is on the outside of the track. The switches and crossings are made from steel rails.

NORTH EASTERN RAILWAY.

The track consists of steel rails of double-headed section, 30 ft. long, weighing 82 lbs. per yd. They are supported in chairs, having a base of 7⅝ ins. × 12½ ins. and weighing 40 lbs. each. The rails have an inward cant of 1 in 20. The ties are 10 ins. × 5 ins. × 9 ft; eleven to each rail length, spaced as follows, center to center; 2 ft. 3¼ ins.; 2 ft. 4 ins.; 2 ft. 8 ins.; 2 ft. 10 ins.; 3 ft.; 3 ft. ½ in.; 3 ft. ½ in.; 3 ft.; 2 ft. 10 ins.; 2 ft. 8 ins.; 2 ft. 4 ins., and 2 ft. 3¼ ins. at the joint again. The rails rest on wooden cushions in the seat of the chairs and are secured in the chairs by wooden keys. Each chair is at ached to the tie by four 22-oz. spikes. The rail joints are even and suspended; they are spliced by plain fish plates and four bolts; the fish-plates weigh 13 lbs. each, and a bolt and nut 24 ozs. The cost per mile, including ballast, is about $6,144.

LANCASHIRE AND YORKSHIRE RAILWAY.

The track consists of bull-headed steel rails, 30 ft. long, weighing 86 lbs. per yd. The chairs have a base of 7¼ × 15½ ins., and weigh 56 lbs. each. The rails have an inward cant of 1 in 20. The ties are 10 × 5 ins. × 9 ft., spaced 2 ft. 9½ ins. and 2 ft. 10 ins., center to center, and 2 ft. at the joints. The rails are secured in the chairs by taper wooden keys. Each chair is attached to the tie by two wrought-iron spikes and two treenails. The joints are suspended, and are spliced with plain fish-plates, fitting close to the web of the rail; the plates are of steel, are 18 ins. long and weigh 28 lbs per pair; the bolts are of steel, with Ibbotson's patent nut. A space of ¼ in. is left between the ends of the rails. The frogs are made of rails planed and spliced, with iron chairs cast to the proper angle and generally embracing the guard rails as well.

For engine-pits, etc., a 72-lb. steel flange rail is used. This form of track shows some interesting points. The rails are 21 ft. long, carried on ties spaced 3 ft. 1½ ins., center to center, and 2 ft. 3 ins. at joint. They are secured to each tie by a "bracket chair", which is practically a pair of short angle bars, 6 ins. long, weighing 5½ lbs. each; these chairs are bolted through the rail by one bolt, in the same way as joint plates; they are fastened to the ties by an ⅛ in. spike and a ⅝-in. coach-screw alternately, the fastenings passing through holes in the horizontal web of the chair. This mode of attachment would seem to be unnecessarily expensive for the class of track for which it is used, but it makes a very safe track for ordinary traffic. This road has a creosoting plant of its own.

MIDLAND RAILWAY.

The track consists of bull-headed steel rails, 30 ft. long, weighing 85 lbs. per yd. The chairs have a base of 7½ × 15½ ins. and weigh 50 lbs. each. The rails have an inward cant of 1 in 20. The ties are spaced as follows under each rail: 2 ft. 2 ins. at joint, 2 ft. 3 ins.; 2 ft. 9 ins.; 2 ft., 11 ins.; 3 ft.; 3 ft.; 3 ft.; 3 ft.; 2 ft. 11 ins.; 2 ft. 9 ins.; 2 ft. 3 ins. and 2 ft. 2 ins. at the joint. The rails are secured by oak keys 7 ins. long. The joints are suspended and are spliced by bent fish-plates, the lower part being curved to embrace the lower head of the rail, so that the bottom edges of the plates nearly meet under the rail. The plates are 18 ins. long, weigh 40 lbs. per pair, and are fastened by four bolts. The frogs are made of steel rails, and the narrowest part of the throat is 1¾ ins. wide. At switches the ties are 12 × 6 ins. or 10 × 5 ins., of suitable length and spaced about 2 ft. 2 ins. With a switch rail 15 ft. long, the stock rail is 19 ft. 6 ins.; with a 15-ft. and an 18-ft. switch rail, the stock rails are 22 ft. and 30 ft. long, respectively. A three-throw switch has a long switch rail of 14 ft. 6 ins, a short switch rail of 12 ft. and a stock rail of 19 ft. 6ins. The sliding chairs of the switch rails rest on a long wrought-iron sole plate, nearly as long and as wide as the face of the tie to which it is fastened; in this way the safe and accurate working of the switch is pretty well assured. The switch rails are cut down near the end so that the tongue is housed under the head of the adjoining rail, and they are also connected near the end by 1¼ in. rods.

GREAT EASTERN RAILWAY.

The track consists of bull-headed steel rails, 30 ft. long, weighing 80 and 85 lbs. per yd, and carried in cast-iron chairs with a base of 6⅝ x 15¼ in. and weighing 43 lbs. each. The chairs are secured to the ties by two ⅞-in. spikes and two ¾-in. oak treenails, and the rails are secured in the chairs by oak keys 7 ins. long. The ties are 10 x 5 ins. x 9 ft. spaced 2 ft. 1 in. at the joints and two ft. 9 ins. at the middle. The joints are similar to those of the Midland track, the fish plates weighing 34 lbs. per pair. No frog is to be laid at a flatter angle than 1 in 8, and as far as possible to be limited to 1 in 6. Frogs to be laid tight to gauge, and each line to cross on the straight for 20 ft. on each side of the crossing. All frogs to give a depth of not less than 2½ ins. clearance for wheel flanges.

GREAT NORTHERN RAILWAY (IRELAND).

On this line, which has the Irish gauge of 5 ft. 3 ins. both bull-headed and flange sections are used. The bull headed rails weigh 75 lbs. per yard, and are spliced with bent plates. The wooden keys are driven on the inside of the track. The flange rails weigh 79 lbs. per yd. and have a 5-in. flange; the seat of the tie is adzed to give the inward cast of 1 in 20. The ties are 10 ins. x 5 ins. x 9 ft; spaced 2 ft. 4 ins. at joints; 2 ft. 10 ins. next to the joints and 3 ft. intermediate. The joints are suspended, and are spliced with one straight and one Z fish-plate. At the ties next to the joints the rail ends are fastened by a jagged spike on the inside and by a fang-bolt, on the outside, the bolt passing through the flange of the rail and having the nut fang underneath, and the square head for crossing upon top. At the middle tie each rail is secured by two fang-bolts with clips holding the flange. At each of the other ties the rails are fastened by two jagged spikes. This road also has a very complete plant for sawing and creosoting its ties.

SEVERN & WYE & SEVERN BRIDGE RAILWAY.

This road, which consists of a number of lines through the coal and iron districts of the Forest of Dean, and which has very heavy grades and curves, was originally laid with flange rails, but double-headed rails are now being introduced. A peculiarity of the flange rail track is that the rails are supported in heavy cast-iron chairs having one jaw. Two fang-bolts pass through each chair, the nuts and washers being on the under side of the tie, and the bolts being screwed up from the top. The inside bolt has a clip washer which holds the flange of the rail, while the outside flange is held by the chair. The base of the rail is 4¼ ins. wide, and the chair has a base of about 5½ × 10½ ins. The main objects of the chair are, of course, to distribute the load, to prevent the rail from cutting the tie, and to prevent the track from spreading at curves. These are very desirable and important points, but a well designed shoe or sole-plate would probably be as efficient, and certainly cheaper. Even on curves such a form of chair would seem to be hardly necessary, except in special cases or under a very heavy, rapid or constant traffic. The flange rails are of steel, 21 ft. long, 72 lbs. per yd., carried on Baltic timber creosoted ties, 10 ins. × 5 ins. × 9 ft., spaced about 2 ft. 8 ins. center to center. The double-headed rails are of steel, 29 ft. long, 80 lbs. per yd., carried in cast-iron chairs which weigh 38 lbs., and are fastened to the ties by two fang-bolts. The ties are as above, but spaced about 3 ft. center to center. The ballast is chiefly furnace slag.

On the Severn Bridge the track consists of rails of bridge section, 24 ft. long, weighing 68 lbs. per yd., laid on longitudinal timbers. The rails are secured to the sleepers by four fang-bolts at the joints, two fang-bolts at the middle and coach-screws at intermediate points. Sole-plates are used at the rail joints. There is an angle-iron guard-rail, 4½ × 4½

ins., fastened to the sleepers by fang-bolts, and tied to the track rails by iron sole-plates. The longitudinal sleepers are of creosoted yellow pine, 14×7 ins., connected by transoms and tie bolts at intervals of 11 ft. (This track is very similar to Brunnel's original type of track for the Great Western Railway, which is still on use in the 7-ft. gauge portions of that line.)

WEST RIDING & GRIMSBY RAILWAY.

The original track of this line was a good example of a heavy flange rail track. It consisted of flange rails 24 ft. long, weighing 83 lbs. per yd., and carried on wooden ties, 10 ins. ×5 ins. ×8 ft. 6 ins., spaced 1 ft. 10 ins. at joints, and 2 ft. 9¼ ins. intermediate. The inward inclination of 1 in 20 was given to the rails by cutting an inclined seat in the tie which seems to be an objectionable feature, as tending to cause the flange to cut into the tie, though this may have been neutralized to some extent in this case by the wide base of the rail, 6 ins. The joints were suspended and were spliced by straight plates, 15 ins. long, weighing 24 lbs. per pair, and from ⅞-in. bolts, the nuts of which were on the inside of the track; the bolts were placed 4 ins. apart, center to center, and weighed 52 lbs. per set of four. The rails were fastened to the joint ties by two ¾ in. fang-bolts, the fang-nut being at the under side of the sleeper, and the head of the bolt bearing on a washer on the rail flange, the bolt passing through a ⅞-in. hole in the flange. The intermediate fastenings consisted, I believe, of spikes and fang-bolts, all passing through the flange, a practice which is costly and in many ways objectionable. The road, however, was acquired by the Great Northern Railway Company, and the track described was taken up and the line relaid with the Great Northern standard track, previously described, entailing what would seem to have been an enormous and unnecessary expense, the new track costing about $8,000 per mile, with rails at $25 per ton. A comparative estimate of the cost of construction for this flange rail track and the old track of the London & Northwestern Railway, with an 84-lb. double-headed rail in chairs, shows $8,641 per mile for the former, and $10,476 for the latter, a difference of $1,835 per mile; these prices are, of course, from old estimates, and are not reliable for modern prices, but as both estimates are for about the same date, they will serve all purposes of comparison.

It will thus be seen that the flange rail is not favorably considered for English railroads, although it has been tried on roads of various classes, and it is rather difficult to understand this, in view of the world-wide use of this type under various conditions of track and traffic. While track on the English system is undoubtedly very solid and durable, it is in my opinion far too solid, containing much unnecessary metal, and consequently entailing unnecessary expense. Of course, if the double-headed section is used (and in referring to this I also include the bull-headed section, which is only a modification), it must be supported in chairs, and, of course, these chairs do some service in distributing the weight over a large area of the tie, although this service is not of sufficient extent to warrant the placing of 25 to 56 lbs of cast-iron at each end of every tie. To strike at the root of the matter, however. I believe this section to be, in the light of modern experience, unscientific and unnecessary. The original theory was brilliant, to make one rail do the work, and last the life of two; but while this appeared plausible, it did not result successfully in practice. The weight of the traffic caused the lower head to be indented by its seat in the chair, so that when this head was put in service, it caused very unpleasant riding for the cars. Different methods were tried to obviate this defect; in some cases (as on the North Eastern Railway, described above) wooden cushions were placed between the rail and the chair, and in other cases attempts were made to suspend the rail by supporting it by the under side of the upper head, which latter plan is still in use to a small extent in India. The results of these various methods, however, may be guessed from the fact that the bull-headed, non-reversible section has been adopted as the standard.

If the railroad companies or engineers would adopt a well-designed, heavy flange rail, and give it good joints and good fastenings, I think there can be little doubt that they would have a track fully as safe and efficient as with the present system, and costing no more for maintenance, but effecting a considerable saving in first cost. Mr. C. P. SANDBERG writes that speed has something to do with the rejection of the flange rail, but states that if these rails are given the same chances as the others in weight, better results will be obtained for less money. As to the matter of speed, however, there is traffic fast and heavy enough in this country, especially on the principal lines of the Eastern States, to prove the capabilities of the flange rail. The track should be designed for the traffic. Sole-plates might be used to prevent the rail from cutting into the ties, and if there is fear of the track spreading, tie-rods might be put in to hold the rails together.

Even if it is conceded that the English type of track, as now laid, is safe and durable, and adapted to the requirements of traffic in England, it was surely a most ill-advised proceeding to introduce it in the colonies; yet it was introduced and is still in use to some extent in India and Australia. In this way the colonies were likely to be overwhelmed with capital expenditure, and it is easy to see that a much greater extent of country might have been developed and made productive by building lines with a track lighter and less costly, but equally efficient for the traffic requirements. In 1876 a track was designed in England for the New South Wales Government Railways, which consisted of 76-lb. double headed rails in 26-lb. chairs. With a flange rail there would be 52 lbs. of cast iron (chairs) per yard saved, or 91,520 lbs. per mile, while a 65 to 70-lb. rail would have been sufficient, especially with the strong fastenings used, in fact a 71½-lb. flange rail was designed for the same system. The flange rail is now, however, extensively used, and its use is extending in India and Australia. The South Australian Government uses flange rails for the Government railroads, and recently let contracts in England for 2,830 tons of 50-lb. steel rails and 2,700 tons of 61-lb. steel rails.

The heads of English rails are of very different section to those of American rails. In general they are rounded, having a succession of curves from the web to the top. The radius of the side of the head is often about ⅛ in. or ¾ in. running into the flat curve of the top table and connected with the web by a sharp reverse curve; sometimes the radius of the side of the head is 2½ ins. the width of the head. The radius of the top table ranges from 5 ins. up. The 76-lb. rail of the New South Wales Government Railways, referred to above, which is a very English rail and is a good sample of this section, had the following dimensions: Height, 5¼ ins; width of heads 2½ ins.; beginning at the middle of the rail, the web was ⅝ in. thick for .92 ins. in height, then it widened out by a curve of .55-in. radius, followed by a short tangent at an angle of about 30° for nearly ½ in. then a curve of .59 in. forming the side of the head running into the curve of 5¼ in. radius which formed the top table. Another section of head, which is very common, has vertical sides and sharp top corners. The rails of the Great Northern Railway (Ireland) have heads 2½ ins. wide; radius of top table 10 ins.: radius of top corners, ½ in.; vertical portion of side 7/16 in. deep; radius of bottom corner, ⅝ in. The Midland Railway has a rail head 2⅝ ins. wide; radius of top table, 5⅝ ins.; radius of top corners ⅝ in.; vertical portion ⅞ in. deep. I think it would be interesting to know how the wear of English rails and wheels compares with that of American rails and wheels.

An objection to the flange rail, and one that has been very strongly urged by the opponents of this section, is that it cuts into the tie, and numerous methods of preventing this have been suggested, such as chairs, sole-plates, etc. Chairs of different designs have been tried but have not been adopted to any extent. Sole-plates have been extensively used on the European continent, and Mr. POST, of the Netherlands State Railways, has obtained satisfactory results from the use of plates with sharp teeth on the bottom which bite into the wood and prevent slipping; these plates are fastened by square headed screws, which also grip the flanges of the rail. A combined chair and sole plate has been invented by M. COBLYN, of Belgium; the plate has on the inner side a jaw which grips the flange of the rail, and on the outer side has a jaw sloping toward the rail and reaching nearly to the height of the top of the web. Over this jaw fits a loose iron cap and a wooden key is driven between the cap and the web of the rail. The arrangement is such that when driven the cap cannot rise vertically, so that the fastening is stable, while a vertical groove in the face of the cap allows the wood to expand and keep the key from working loose. This system has the advantage of supporting the rail near the head and has already been adopted by some Belgian roads.

There is one feature especially in English track which should be well considered by American engineers, and that is the system of fastenings. More attention should be paid to this important part of the track, the old-fashioned and still generaly used method of spiking being insufficient for modern requirements, and being probably responsible for a large number of train accidents. With the exception of a few cases where some improved device has been adopted, such as the case of the New York Central, which uses the Bush interlocking bolts at the joints and the middle of the rails, the rails are held to the ties by the spikes only. The ordinary spike cannot, and does not, hold under heavy traffic, and anyone who cares to make a little observation can learn some very startling facts in the matter of rail fastenings.

The ties are generally creosoted; the creosoting being done sometimes by contract and sometimes at works owned by the company.

In England the chairs are fastened to the ties by screws, round spikes, plain treenails, compressed treenails (which expand and make a very tight fastening), or hollow treenails into which round spikes are afterwards driven; sometimes fang-bolts are used. Fang-bolts are very extensively used for securing flange rails; the bolts either pass through the flange of the rail, or through clips which hold the flange; the fang-plate is sometimes made in one piece with the nut, and sometimes as a separate plate; this plate and the nut are on the underside of the tie, and the bolt is screwed up from the top. On the Midland Great Western Railway (Ireland), the rail ends rest on a sole-plate, the bolts pass through the plate, having washers which hold the rail flange, and on the under side of the tie is a narrow channel plate of iron through which both bolts pass, the bolt heads fitting into the channel. A similar arrangement is used at the middle tie of each rail length, and square spikes, two to each rail, are used at all the other sleepers. Jagged spikes are occasionally used. Coach-screws are also used, and these screws or screw spikes are used extensively on the Continent, being also used for SANDBERG's "Goliath" (110-pound rail).

In England, also, the rail joints are not so troublesome as in this country. The ordinary standard joint consists of a pair of straight fish-plates 18 ins. long, with four bolts. The holes are spaced 4½ ins. center to center, those in the rail are 1+1⅛ ins. oval, and those in the plate 1 in. square; for these dimensions a ⅞-in. bolt would be used; the bolts have usually a hemispherical head and a square neck. For double-headed rails there are also the deep plates already described with the lower part bent so as to almost embrace half the lower head of the rail. For flange rails angle bars are sometimes used; also *Z* plates, with a vertical web projecting below the flange of the rail. When laying track at ordinary temperatures, a space of 3/16 or ¼ in. is left between the ends of the rails.

While the American type of track is probably the best that could be designed, there are matters of detail in which it is open to improvement, and in some of these matters something may be learned from European practice.

The ballast consists generally of broken stone or furnace slag, on some lines covered with a boxing of gravel; burnt clay is also sometimes used. It is kept in apple pie order and in good condition. On the Midland Railway the ballast has a flat outer slope, and is brought up nearly level with the underside of the head on the outside of the track, and level with the tops of the ties between the rails.

APPENDIX A.

LANCASHIRE & YORKSHIRE RAILWAY — ESTIMATE OF COST FOR ONE MILE OF SINGLE TRACK.

Rails	3,520 yds.	135.1 tons,	at	$22.50		$3,039.75
Chairs	3,872 No.	96.8	"	"	15.00	1,452.00
Fish plates	352 "	2.2	"	"	27.50	60.50
Fish bolts	704 "	6	"	"	80.00	48.00
Spikes	7,744 "	3.9	"	"	32.50	126.75
Ties	1,936 "			"	75	1,452.00
Treenails	7,744 "			"	17.50	135.52
Keys	8,872 "			"	19.50	75.50
Laying 1,760 yds.					25	440.00
Total						$5,830.92

APPENDIX B.

WEIGHT OF LOCOMOTIVES.	WEIGHT IN GROSS TONS.	
	On Driving Axle.	Total.
Mersey Railway—Tank engine, cpl'd, 4-wheel trailing truck	18	68
Lancashire & Yorkshire Railway—Express engine, 4 coupled 4-wheel leading truck	14¾	59
Great Western Railway — Expr. Engine single, 4 leading and 2 trailing wheels	16	49
Great Northern Railway—Expr. engine, single, 4-w lead truck, 2 trailing wheels	17	45
North Eastern Railway — Express, compound, 4 coupled, 2 leading wheels	18	43
Midland Railway—Express Engine, 4- ouple d, 4-wheel leading truck	15	43
London & North Western Railway — Express compound, 4-coupled, 2 leading wheels	15	42¾
Caledonian Railway — Express, single, 4-wheel, leading truck, 2 trailing wheels	17	42
North Eastern Railway—Freight engine, compound, 6-coupled.	12¾	33

The Manufacture of Dynamo Machines and Electric Lighting Apparatus.

(Continued from page 531.)

The Incandescent Dynamo Department occupies the balance of the dynamo room in the basement of factory B. The incandescent machine, Fig. 6, furnishes a current of low potential, and is wound in such a manner as to require no regulator. It is especially adapted to areas having a radius of 1,500 to 3,000 ft. from the central station. The capacity of one of these machines is 1,000 lights. It has self-containing ball bearings, and the inclined series coil and fluid magnets, said to be one of Prof THOMSON'S greatest inventions. It is so designed that by the inclined position of the coil the magnetic effects in the coil keep the current constant at the terminals of the machine, and it is so wound that the potential does not increase when the load or number of lamps decrease. The copper wire for the inclined series coil is very coarse, being 00 wire, or about ¼ ins. in diameter, and is bent and hammered into shape by suitable apparatus. The field magnets are wound by machinery operated by steam power.

The Alternating Incandescent Dynamo is a third form of machine, and furnishes a current of high potential at a minimum cost for power. It does not require a separate apparatus to excite the field magnets, certain coils producing a commuted constant current that is employed in the bobbins of the field magnet. This has 14 pole pieces upon a cast-iron core, connected in series, and wound in conical form to allow space for ventilation between them. The wire is wound by machinery on cast-iron sleeves which are slipped over the cores. The armature for these machines are unlike those for the arc dynamos, but are built up of very thin wrought-iron plates, 490 in number, interleaved with tissue paper, for the avoidance of wasteful magnetic currents which would otherwise heat, and finally become destructive to the machine. The wire is wound in a single layer upon the armature which gives great radiating surface, and reduces the magnetic resistance to a minimum. The machines here were for 500 lights. In using the current for incandescent lighting it is passed through a reversed induction coil, or transformer, which reduces its potential to that required for the lamps.

Motor Dynamos.—Motors are made for powers from ½ to 75 H. P. The armatures of these machines are cylindrical, and are made up of laminated sheet iron plates wound with wire in a manner peculiar to this form. They are constructed according to voltage required, from 110 to 600, and of varying sizes. A 200 volt motor requires twice the length of wire, giving twice the number of turns, of a 100 volt motor. A 15 H. P. motor of 220 volts, has 64 divisions on the drum of the armature, and is wound with four turns of wire in two layers. As the voltage increases, the necessary size of wire decreases, for the same horse power. Motors carrying a load of 60 H. P. have been in operation at the works.

All the wire wound in this department, after passing through a straightening apparatus containing a number of pairs of rollers, between which the wire is drawn, passes through a counting device, which records the length put in each coil. On the largest, or M. D. armature, 325 lbs. of wire are used, equal to 14,000 ft., or over 2¾ miles.

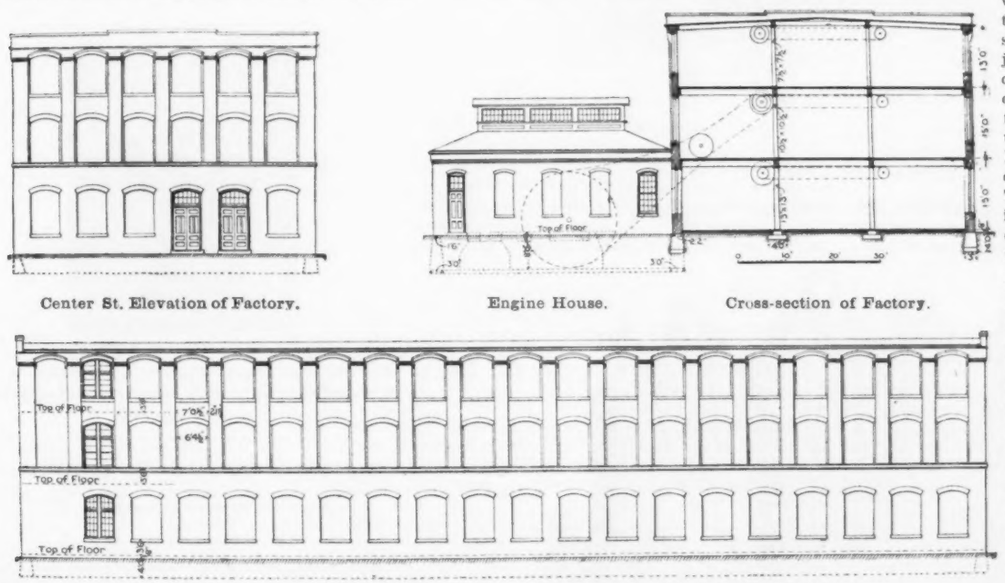
Adjoining is an electric testing room containing reflecting galvanometers, a Sir William Thompson potential indicator or voltmeter, (a very delicate instrument) a Carden voltmeter, in which the needle is moved by the expansion of a platinum-indium wire and a Magdeburg tachometer for speed indications.

Near this point the boiler house is situated. It contains two boilers of 100 H. P., which supply steam for running a 250 H. P. engine for factory B, and three 60 H. P. boilers which supply steam to the engine for factory A and the dynamo testing room, the pipes being connected between the two sets.

In an adjunct to factory A is the brass snagging room, the power for which is supplied by a 5 H.P. electric motor. Name plates are filed, drilled, tapped and finished, and the background blocked. The commutator bars are finished here, also rough filing and finishing of plates for the globe holders of arc lamps. Adjoining is the dipping department, with nitric acid and potash baths for brightening brass and composition work.

The Arc Lamp Department occupies the second floor of factory *B* and is connected with the floors above and below by an elevator provided with self-closing hatches. The room has two main lines of shafting and is filled with machinery, including many multiple drills. A Prentice milling machine finishes the tops of lamps. The air dash pots are fine specimens of accurate fitting and fine work. All work is done by jigs and is made interchangeable.

A turret lathe working five tools is used for making the cores of magnets for the lamps out of iron rods, some 9 ft. long, and produces 1,000 to 1,200 per week. Many turret lathes are also employed for finishing the brass fittings. The production in this department is about 600 lamps per week. The lightning arresters, Fig. 10, are so constructed that the arc formed by the passage of the lightning current to earth is blown out by the action of a double pole electric magnet. The connections for the lamp contacts are of pure silver, the use of which prevents oxidation. The rods or pipes forming the continuation of the carbon holders requires to be very carefully straightened and polished, which is done by machinery and test planes. Formerly every rod was polished by hand and required ten minutes' time, but it is now polished by two buffing wheels between which the rod is passed and finished very quickly. The necessity of great perfection in this work is appreciated when it is seen that the magnets hold this rod in such position as to accurately adjust the length of arc between the carbons at each instant, and are required to move it through minute fractions. The adjoining room is used as a repair department for arc lamps. Here specimens of the earlier Thomson lamps are seen. The improved Thomson-Rice lamp is much shorter and does away with one of the two parts of magnets formerly used, introducing a spring in place of it. The remaining pair is wound double, and other changes were made in the cut-out and relighting device which makes the lamp now much smaller and neater, giving the same service. Insulation is very carefully attended to; asbestos, rubber and prepared fibre being used. The next room contains the arc lamp assembling department, in which most of the workmen are graduates of technical schools and all experts. Here the parts of the lamps are put together with all the necessary connections and accurately adjusted. When working perfectly as a machine, each man ties a tag with his name on it to the lamp and in case of a defect being discovered later it is returned to the one fitting it up. A bench, vise and gauges for every part are the principal part of the apparatus required. The work of fitting the arc light carbon holders is very delicate, as the rods must move but $\frac{1}{10}$ of an inch in some cases in adjusting the length of arc. The lower carbon holders also have a self-centering device for adjustment.



Center St. Elevation of Factory. Engine House. Cross-section of Factory.

Front Elevation of Factory.

Fig. 2.—The Thomson-Houston Electric Co's Factory at Lynn, Mass.

Adjoining this room is the arc light testing room. A large switchboard on one wall controls the current for each row of lamps, of which there are ten, 17 lamps being hung in each row. The spring plugs of the switchboard allow of the connection of the dynamos down stairs with any row of lamps. The rows are separated by short suspended board fences to diminish the glare and the carbon points may be examined through colored glasses. Arc lamps are made either of 1,200 or 2,000 candle power and require from 0.5 to 0.8 of a horse power each. They are made either single or double; in the latter case double sets of carbons are furnished to continue the duration of the lamps operation, the second set of carbons coming into action automatically as soon as the first set is exhausted. A special lamp with

carbons half the usual length is made for certain places where a shorter lamp is required.

Adjoining is the packing and shipping department for factory *A*, where the lamps, as well as the dynamos from the floor below, and all the products of the works, conveniently come together for boxing and packing and delivery to teams.

The sheet metal work, such as lamp hoods of galvanized iron, spark protectors of wire screens, which the insurance law requires to be used for the lamps in places where there is inflammable material, etc., is done on the second floor of factory *A*.

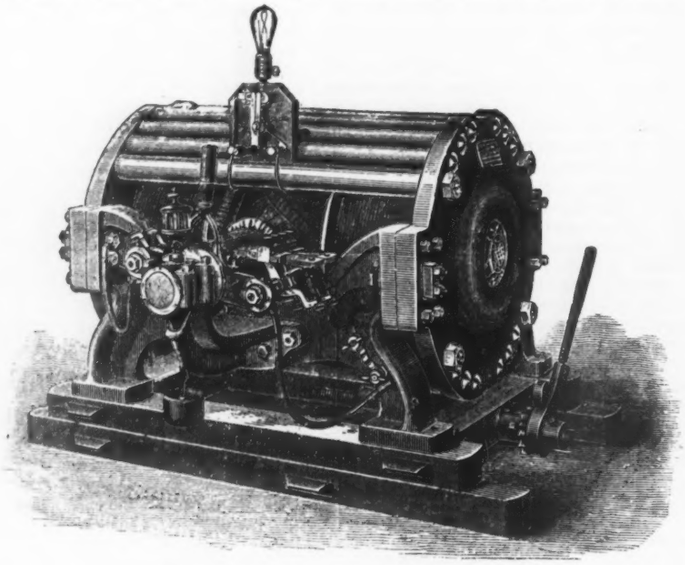


Fig. 6.—Dynamo for Incandescent Lighting.

There is located here a 50 arc-light dynamo and switchboard connected to the other parts of factory *A*, and also a 400 light incandescent machine. Adjoining is a machine shop for master machanics and tool makers where all jigs and special machines and tools are made. Besides the usual lathes, planers and milling machines, a fine Brown & Sharpe surface grinder is used for making even polished surfaces by means of a corundum wheel and a slide rest attachment, combined with a planer motion. The wheel consists of a cast-iron blank with a toothed surface on which sapphire corundum is glued, and is used for purposes requiring a harder substance than emery.

A large paraffine bath is used for the dipping of the woodwork of switches, etc. In the Inspectors department every small part of the machines has test gauges applied to it to insure interchangeability, and electrical testing is also done. The individual distributors, which are placed in multiple on one side of an arc circuit, are in use here. By means of them, incandescent lights can be operated in connection with arc lighting, the incandescent lights being independent.

Adjoining is the stock room where finished apparatus is stored, and next to this is the supply department where all material that comes into the factory is brought. The number of orders for material per day is 700 to 800, material being obtained by tickets or orders from the foreman of each department.

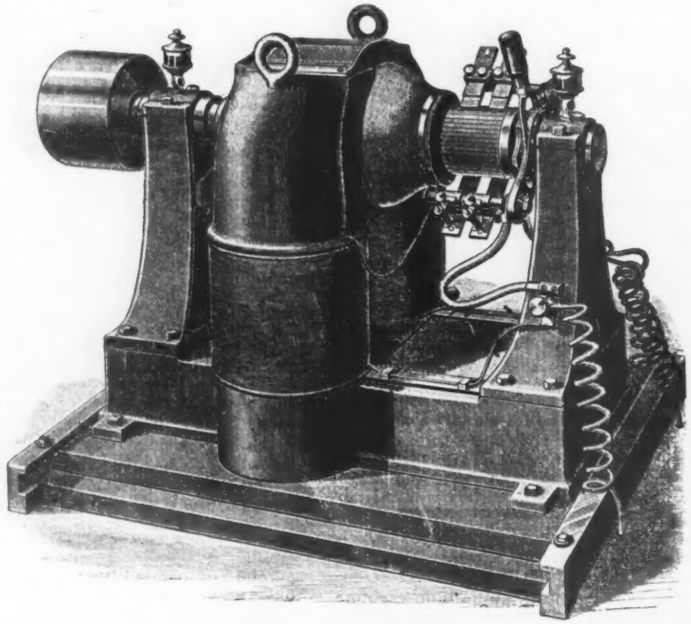


Fig. 7.—Motor Dynamo.

The general offices include the draughting room, having eight or ten draughtsmen and several girls to do tracings; Prof. RICE'S office, in factory *B*; the Library of Reference room, where all the electrical books and periodicals published in the United States, besides several German and French periodicals and many scientific works, are kept: Prof. THOMSON'S study, and adjoining, Prof. THOMSON'S private laboratory and experimental shops.

In the rear of these rooms, on the third floor of factory *B*, is a large pattern room and carpenter shop for fine wood work, where the machinery is so arranged as to make work exactly interchangeable.

(TO BE CONTINUED).

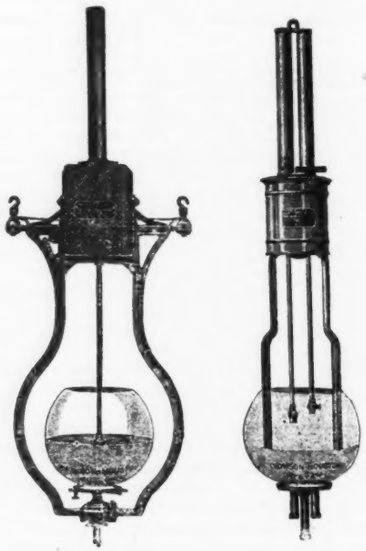


Fig. 8.—Single Arc Lamp. Fig. 9—Double Arc Lamp

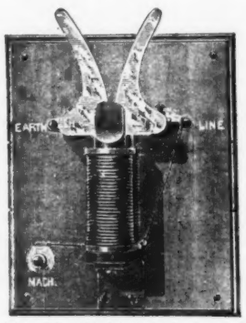


Fig. 10.—Lightning Arrester.

Explosives and their Composition.*

BY WOLCOTT C. FOSTER.

(*Concluded from page 534.*)

Gun Cotton, (Pyroxyline, Nitro-cellulose) is ordinary cotton nitrated by being dipped into a mixture of strong nitric and sulphuric acids, and then thoroughly washed until every trace of acid has disappeared. It is said that damp gun cotton (25 per cent. of water) acts more powerfully than dry. Drinker's *Explos. Comps.*, *pp.* 40, 62 to 65, 95; Hill, *Explosives*; *Van Nostrand's Magazine*, 18, 40; Eissler, *Modern Explosives*; Schoen, *Der Tunnelban*; Wagner's *Chem. Tech.*, p. 160; *Jour. Soc. Chem. Indust.*, 5.502; *Ibid.*, 3.329-30; *Dingl. Polyt. Jour.*, 250.466; *Ibid.*, 251.371; *London Chem. News*, *pp.* 234; and numerous papers in the various technical journals and transactions of learned societies.

Gun Powder consists of a mixture of potassium nitrate, sulphur and charcoal, varying in proportions of the several ingredients according to the purity of materials, the use to which the powder is to be put, and to the ideas of the different manufacturers.

The average of seven analyses of different kinds of blasting powder used for mining purposes is as follows:

Potassium nitrate	63.33	per cent.
Sulphur	15.89	"
Charcoal	19.39	"
Hygroscopic water	1.36	"

(Drinker's *Explos.*, p. 57.)

The following analyses are given by RZIHA:

	Potassium Nitrate.	Charcoal.	Sulphur.
Austrian blasting powder	60.194	21.359	18.447
French round grain blast. pow.	62.60	18.00	20.00
Harz blasting powder	62.11	21.28	16.41
Russian blasting powder	66.70	16.70	16.60
Westphalian blasting pow.	63.34	15.83	15.83

(*Ibid.* p. 57)

The theoretical proportions for obtaining the best results are:

Potassium nitrate	74.84
Sulphur	11.84
Charcoal	13.32

Musket powder as made by the English Government consists of:

* Copyrighted 1888 by W. C. Foster.

Potassium nitrate	75 per cent.
Sulphur	10 "
Charcoal	15 "

The references to articles on gunpowder are too numerous for the scope of this list, but excellent short descriptions of it may be found in Drinker's *Tunneling* and *Explos. Comps.* and also in Wagners's *Chem. Tech.*

Gun Sawdust, Schultze's Wood Gunpowder) is sawdust treated with a mixture of nitric and sulphuric acids and then thoroughly washed and mixed with one or more nitrates. It is somewhat similar in its properties to gun cotton. Subsequently mixing from 17 to 20 per cent. of nitro-glycerine with it was tried. (This explosive is not the same as Dittmar's Dualin, in which the sawdust acts as an absorbent for the nitro-glycerine.)

Drinker's *Explos.* p. 62; Wagner's *Chem. Tech.* p. 154.

Hall's Explosive consists of gun cotton and (nitro?) starch.

Haloxyline from Chrast and Cili consists of:

Potassium nitrate	75 parts.
Sawdust	15 "
Charcoal	8⅓ "
Potassium ferricyanide	1⅔ "

Dingl. Polyt. Jour., 255,534; Wagner's *Chem. Tech.*, p. 154; Drinker's, *Explos. Comps.* p. 60; Schoery *Der Tunnelbau*, p. 64.

Hecla Powder.—The composition of the dope is not known, but the various brands contain the following percentages of nitro-glycerine:

No. 1 X X	75 per cent.
No. 1 X	50 "
No. 1	40 "
No. 2 X	35 "
No. 2	30 "
No. 3 X	25 "
No. 3	20 "

Hellhoffite consists of binitro-benzene and fuming nitric acid. It possesses the following advantages: 1. In igniting it with fulminate of mercury it acts more powerfully than nitro-glycerine. 2. It may be transported and stored with perfect safety as regards concussion, as it cannot be exploded by either a blow or a shock, nor by an open flame. On the other hand it has the following disadvantages: 1. Hellhoffite is a liquid. 2. The fuming nitric acid contained in hellhoffite is of such a volatile nature that it can be stored only in perfectly closed vessels. 3. Hellhoffite is rendered completely inexplosive by being mixed with water. *Engineer*, Aug. 28, 1885; *Eng. and Min. Jour.*, Oct. 3, 1885; *Jour. Soc. Chem. Indust.*, 4, 136; *Ibid.*, 5,502; *Dingl. Polyt. Jour.*, 254, 110; *Ibid.*, 261, 25-29; *Lond. Chem. News*, Dec. 17, 1886.

Heracline is sawdust saturated with a solution of picric acid, and then mixed with potassium or sodium nitrate and sulphur.

Hercules Powder according to U. S. patent specifications consists of:

No. 1 which is No 1 XX as made:

Magnesium carbonate	20.85 parts.
Potassium nitrate	2.10 "
Potassium chlorate	1.05 "
White sugar	1.00 "
Nitro-glycerine	75.00 "

No. 2

Magnesium carbonate	10.00 "
Potassium nitrate	31.00 "
Potassium chlorate	3.34 "
Sugar	15.66 "
Nitro-glycerine	40.00 "

The other grades contain:

No. 1 X X	75	per cent nitro-glycerine.
No. 1	65	" "
No. 2 S S	55	" "
No. 2 S	50	" "
No. 2 S	45	" "
No. 2	40	" "
No. 3 S	35	" "
No. 3	30	" "
No. 4 S	25	" "
No. 4	20	" "

U. S. Pat., 157,054, Nov. 17, 1874.

Himley's Powder consists of potassium chlorate, potassium nitrate, and coal tar pitch. The following analyses of samples taken from different portions of the same lot of powder will show how it varies in composition.

	Sample. No. 1.	Sample. No. 2.	Sample. No. 3.
Potassium chlorate	45.50	33.50	62.50
Potassium nitrate	34.38	48.78	25.00
Coal tar pitch	20.12	17.72	12.50

Jour. Soc. Chem. Indust., 4, 367.

Hind's Explosive (London) consists of:

Nitro-glycerine	64.00 per cent.
Ammonium nitrate	12.00 "
Chalk	0.25 "
Coal	23.00 "
Sodium Bicarbonate	0.50 "

Hochstadter's Gun Paper is unsized paper soaked in a thin paste of potassium chlorate, charcoal, and sulphide of antimony. Reichen's modification of Hochstadter's gun paper consists of strips of unsized paper soaked in a paste of potassium chlorate, potassium nitrate, charcoal, and gum. *Ecl. Eng.* 9,334; Drinker's *Explos. Comps.*, p. 62.

Horn Powder consists of gun cotton saturated with nitro-benzol and acetic ether, producing a dense waterproof mass, which is afterward granulated.

Horseley's Powder at first consisted of chlorate of potash and nutgalls or resin. It was subsequently mixed with 20 to 25 per cent. of nitro-glycerine. *Ecl. Eng.*, 9,342; Drinker's *Tunneling* and *Explos.*; *U. S. Pat.*, 98,382, Dec. 28, 1869.

Janite consists of

Potassium nitrate	75 parts
Sodium picrate	3 "
Potassium chlorate	2 "
Sulphur	10 "
Lignite	10 "

It s a gray, coarse grained powder, and is principally used in coal mining. *Eng.* and *Min. Jour.*, Aug. 7, 1880; *Dingl. PolygtJour.*, 256,525.

Jelly Powder—See Blasting Gelatine.

Judson Powder consists of from 1 to 20 per cent. of nitro-glycerine mixed with a non-absorbent powder having the following composition:

Sodium nitrate	70 parts.
Sulphur	15 "
Resin	3 "
Asphalt	2 "
Anthracite coal	10 "

No. F F F contains 20 per cent. nitro-glycerine.
No. F F " 15 " "
No. F " 10 " "
No. R R P " 5 to 6 " "

Jour. Soc. Chem. Indust., 5,502; *Proc. Nav. Inst.*, 11,280; *U. S. Pat.*, 183,764, Oct. 31, 1876; Drinker's *Explos. Comps.*, p. 104.

Judson Giant Powder No. 2 consists of:

Nitro-glycerine	40 parts by weight.
Sodium nitrate	40 " "
Resin	6 " "
Sulphur	6 " "
Infusorial earth	8 " "

U. S. Pat., 130,468, June 3, 1873; Drinker's *Explos. Comps.*, p. 102.

Kieselguhr Dynamite.—See Nobel's Dynamite No. 1.

Kinetite is a gelatinous mass consisting of:

Nitro-benzene	16 to 21 parts.
Gun cotton	¾ to 1 "
Chlorate or nitrate of potassium	82¼ to 75 "
A sulphide, as antimony pentasulphide	— to 3 "

This explosive is liable to spontaneous ignition. *Ger. Pat.*, 31,786, June 8, 1884; *Eng. Pat.*, 10,986, Aug. 6,1884; *Berg-und Hutten-Mannischen Ztg.*, p. 65, 1885; *Dingl. Polyt. Jour.*, 256,408; *Jour. Soc. Chem. Indust.*, 4,569; *Ibid.*, 6, 2 to 12; 10th *Ann. Rep. H. M. Inspec. Explos.*; *Engineer*. June 4, 1886.

Koppel's Explosive.

	No. 1.	No. 2.
Potassium nitrate	35.00 per cent.	42.00 per cent.
Soda	19.00 "	22.00 "
Sulphur	11.00 "	12.50 "
Sawdust	9.50 "	10.00 "
Potassium chlorate	9.50 "	
Charcoal	6.00 "	7.00 "
Sodium sulphate	4.25 "	5.00 "
Potassium cyanide	2.25 "	
Refined sugar	2.25 "	
Picric acid	1.25 "	1.50 "

No. 1 is proposed for hard rocks, such as basalt; No. 2 for soft rocks, such as sandstone. *Eng. and Min. Jour.*, Aug. 11, 1883.

Lannoy's Powder is a variety of Lithofracteur which is manufactured in Belgium, and consists principally of sulphur, sodium nitrate and nitrated bran. It is used for blasting but is objectionable on account of a most disagreeable smoke which it produces.

Leatherite consists of:

Potassium nitrate	45 parts.
Sulphur	15 "
Leather scraps	18 "
Picric acid	2 "
Red lead	20 "

Dingl. Polyt. Jour., 255,525.

Lignite of Ballabene consists of:

Nitro-glycerine	80 to 85 parts.
Nitro-cellulose	20 to 15 "

The nitro-cellulose is obtained by the nitration of wood flour. *Jour. Soc. Chem. Indust.*, 4,366.

Lignine.—See Cellulose Dynamite.

Lignose is wood fibre saturated with nitro-glycerine with or without the addition of a nitrate. *Chem. Tech. Ztg.*; *Ebsler, Mod. Explos.*, p. 95.

Lithofracteur as manufactured by Krebs Bros. & Co. consists of:

Nitro-glycerine	52 per cent.
Infusorial silica and sand	30 " "
Carbon (coal)	12 " "
Sodium Nitrate and formerly barium nitrate	4 " "
Sulphur	2 " "

It has obtained considerable favor in some parts of Europe. Drinker's *Tunneling*, p. 85; do *Explos. Comps.*, p. 87; *Ecl. Eng.*, 5, 173; *Ibid.* 1., 343.

Lithofracteur formerly consisted of potassium nitrate, sulphur, and nitrated sawdust or bran. This is now called Lannoy's Powder.

Liverpool Cotton Powder is a mixture of gun cotton and potassium nitrate. *Eng. and Min. Jours*, Apr. 16, 1881.

Mackie's Granulated Gun Cotton is a mixture of ground gun cotton with a solution of sodium nitrate and sugar. It contains after drying:

Gun cotton	63 per cent.
Sugar	32 " "
Sodium nitrate	5 " "

Melinite.—Under this name M. EUG. TURPIN claims the use of trinitrophenol or picric acid of commerce, unmixed with any oxidizing substance, as an explosive. *Proc. Nav. Inst.*, 14, 151.

Metalline Nitroleum consists of nitro-glycerine absorbed by red lead. Drinker's *Tunneling*, p. 86; do., *Explos. Comps.* p. 88,

Mica Powder invented by MOWBRAY was used very extensively at the Hoosac Tunnel. It is composed of nitro-glycerine absorbed by mica scales. Under favorable conditions the mica will retain 52 per cent. of nitro-glycerine. Drinker's *Explos. Comps.*, p.p. 88 to 90; Mowbray *Trinitro-Glycerine*; *U. S. Pat.*, 150, 428, May 5, 1864.

Michalowski's Blasting Powder is bulky and requires to be well rammed in the bore hole. On account of the large amount of potassium chlorate that it contains, it is quite sensitive to blows. It consists of:

Potassium chlorate	50 per cent.
Manganese dioxide	5 " "
Organic matter finely pulverized (bran)	45 " "

Proc. Nav. Inst., 13, 244; *Jour. Soc. Chem. Indust.*, 3, 646; *Dingl. Polyt. Jour.*, 252, 153.

Millot's Dynamite consists of nitro-glycerine absorbed by sugar.

Miner's Friend Dynamite.

No. 1 X contains:

Nitro-glycerine	33 per cent.
Sodium nitrate	50 " "
Charcoal	17 " "

No. 1 X X	— contains	75	per cent.	of nitro-glycerine.
No. 1 X S	"	60	"	"
No. 1 X	"	50	"	"
No. 1 S	"	45	"	"
No. 1	"	40	"	"
No. 2 X	"	33	"	"
No. 3 X	"	27	"	"
No. 3	"	20	"	"

Mylin.—The composition of this explosive is unknown. *Dingl. Polyt. Jour.*, 255, 525.

Neptune Powder contains:

Nitro-glycerine	32.66 per cent.
Sodium nitrate	45.04 " "
Charcoal	17.44 " "
Sulphur	4.88 " "
Ash	0.94 " "

Neumeyer's Powder is said to be composed of the same ingredients as common gunpowder, but mixed in different proportions. It was introduced into England in 1866, but did not come into general use. Drinker's *Explos. Comps.*, p 62; *Paper on Explosives*, by PERRY NURSEY, before *Soc. Eng. London*, 1866.

Newton's Explosives consists of one part of gun cotton and two parts of a solution containing equal weights of Zinc nitrate and cupric nitrate. *Eng. Pat.* 5,382, 1884; *Jour. Soc. Chem. Indst.*, 4, 417.

Nitrate of Ammonia Powder.—See Ammoni Powder.

Nitrated Gun Cotton is gun cotton mixed with some nitrate.

Nitro-Cane Sugar.—See Fulmin-Sugar.

Nitro-Cellulose.—See Gun Cotton.

Nitro-Cellulose Dynamite.—See Cellulose Dynamite.

Nitro-Colle.—Glue is allowed to stand in cold water until it has absorbed all that it will, and then it is solidified by treatment with nitric acid, after which it is treated with a mixture of nitric and sulphur acids and then washed, as in making nitro-glycerine. *Proc. Nav. Inst.*, 13, 547.

Nitro-Glycerine.—(Fulminating Oil, Nitroleum Trinitrine, Glyceryе-nitrate, Glonoine, Trinitro-Glycerine, (Mowbray, *Trinitro-Glycerine*). Drinker's *Tunneling and Explos. Comps.*; Wagner's *Chem. Tech.*; Eissler, *Modern Explos.*

Nitroleum is one of the names given to pure nitro-glycerine.

Nitrolite is similar in its composition to double ammonia powder with the exception that the nitro-cellulose is obtained from some other source than cotton. It has a light brownish-grey color.

Nitro-Mannite.—See Fulmin-Mannite.

Nitro-Molasses is prepared by treating molasses with a mixture of nitric and sulphuric acids in a similar way to the manufacture of gun cotton and nitro-glycerine. It boils at 180° to 200° C., and detonates between 230° and 250° C. For blasting it is recommended that it be mixed with sawdust, tan bark, or bran impregnated with potassium nitrate. *Eng. Pat.*, 1885, 1883; *Jour. Soc. Chem. Indst.* 3, 35.

Nitropylin.—See Volkmann's Wood Powder.

Nitro-Starch.—(Xyloidine Pyroxame) is nitrated starch. Drinker's *Explos. Comps.*, p.p. 40, 62.

Nitro-Sugar.—See Fulmin-Sugar.

Nitro-Toluol consists of three parts of nitro-benzol dissolved in seven parts of nitro-glycerine. Drinker's *Tunneling*, p. 68; do., *Explos. Comps.*, p. 70.

Nobel's Dynamite:

No. 1	75	per cent	Nitro-glycerine	25	per cent. dope.
No. 2	75	"	"	25	" "
No. 3	35	"	"	65	" "
No. 3 B	30	"	"	70	" "

Dope for No. 1 is pure infusorial earth; For Nos. 2, 3, 3B, A mixture of potassium nitrate, wood fiber, rosin, soda, and infusorial earth.

No. 1 is also called kieselguhr dynamite. It explodes at 182.3° C. For descriptions of, and papers relating to these dynamites, see the various works on explosives and the technical journals and publications of the different learned societies.

Nobel's Powder is ordinary gunpowder saturated with nitro-glycerine.

Norrbin and Ohlsson's powder consists of:

Ammonium Nitrate	30 parts by weight
Coal	6 to 8 " "
Nitro-Glycerine	10 to 20 " "

Drinker, *Explos. Comps.*, p. p. 91, 102; *U. S. Pat.* 141, 585, Aug. 5, 1873.

Oriental Powder is sawdust, tanbark, or other vegetable fibre, saturated with a solution of a nitrate or chlorate, dried and then mixed with gunpowder. *U. S. Pat.*, 88, 171, Mch. 13, 1869.

The powder known as the safety compound of the Oriental Powder Co., is said to be composed of potassium chlorate, potassium nitrate, and crude gamboge. *Johnsons Cycl.*, 2,789.

Paléine is a French powder and is made in five grades, from A to E. No. A contains from 40 to 50 per cent. of nitro-glycerine with 60 to 50 per cent. of nitrated straws. No. A is said to be about ⅛. No. B about ¼, and No. C slightly more powerful than No. 1 kieselguhr dynamite. *Jour. Soc. Chem. Indust.*, 4,366.

Panclastite consists of two volumes of carbon-disulphide mixed with three volumes of nitrogen-tetroxide. This explosive was put forward by M. ENG. TURPIN and claimed by him as his discovery, whose in reality it is one of the explosive mixtures suggested by SPRENGEL. *Jour. Soc. Chem. Indust.*, 3, 532; *Ibid.*, 5, 199; *Dingl. Polyt. Jour.*, 253, 70.

Paper Blasting Powder.—See Dynamogen.

Parone's Explosive is a mixture of:

Potassium chlorate	2 parts
Carbon disulphide	1 part

Proc. Nav. Inst., 13, 547.

Petralite is said to consist of:

Potassium nitrate	64 parts
Charcoal	30 "
Antimony sulphide	6 "

It is made by Prochaska & Lisch at Buda Peath and is recommended for coal mining. *Eng. and Min. Jour.*, Aug. 7, 1880; *Dingl. Polyt. Jour.*, 255, 524.

Petrofactreur consists of:

Nitro-benzene	10 per cent.
Potassium chlorate	67 "
Potassium nitrate	20 "
Antimony pentasulphide	3 "

It is slowly decomposed at 340° leaving a white residue. *Jour. Soc. Chem. Indust.*, 6, p. 4.

Picric Powder.—See Abel's powder.

Polynitro Cellulose contains:

Potassium nitrate	65 to 93.20 parts
Sulphur	12.00 "
Lampblack	3.00 "
Tanoark	20 to 25.00 "
Ferrous sulphate	1.40 to 27.80 "
Glycerine	0.92 to 1.84 "

The compound is unalterable in the air and is used in the form of compressed cartridges. It is absolutely harmless and can be handled with impunity. ENGINEERING NEWS, July 2, 1887; *Le Genie Civil*, May 7, 1887.

Pontopolite consists of nitro-naphthalene dissolved in nitro-glycerine.

Porifera Nitroleum is nitro-glycerine absorbed by sponge. Drinker's *Tunneling*, p. 86; do., *Explos. Comps.*, p. 88; *U. S. Pat.*, 98,753, Aug. 17, 1869

Potentite is a nitrated gun cotton. *Proc. Nav. Inst.*, 11.87; *Eng. and Min. Jour.*, Sept. 15, 1883; *Jour. Soc. Chem. Indust.* 2, 310.

Poudre Barytique.—See Saxifragine.

Pudrolithe.—See Pyrolythe.

Punshon and Vizer's Powder consists of picric acid made up in cartridge form, containing a glass bottle filled with nitric acid. Upon breaking the bottle a very powerful explosive is formed. This is one of the explosive mixtures suggested by SPRENGEL.

Pyrolithe (Pudrolithe) is a blasting powder very similar to Kellow's Powder. *Ecl. Eng.*, 9, 335; *Eng. and Min. Jour.*, Sept., 15, 1883.

Pyronene is a mixture of:

Sodium nitrate	52.5 parts
Sulphur	20.0 "
Spent tan	27.5 "

Wagner's *Chem. Tech.*, p 154.

Pyroneme consists of

Potassium nitrate	69 parts.
Sulphur	9 "
Charcoal	10 "
Antimony (metallic)	8 "
Potassium chlorate	5 "
Rye flour	4 "
Potassium chromate	small amount.

Ann. Cycl., 1885, p. 345.

Pyropaper consists of a nitrated unsized cotton or linen paper.

Pyroxame.—See Nitro-starch.

Pyroxyline.—See Gun Cotton.

Rack-a-rock consists mainly of

Potassium chlorate	77.7 per cent.
Nitro-benzol	22.3 " "

It has a specific gravity of 1.7 Drinker's. *Explos. Comps.* p. 61; *Eng. and Build. Rec.*, Nov. 26, 1887; *Jour. Soc. Chem. Indust.*, 3, 648.

Red Dynamite.—See Dynamite Rouge.

Reichens Gun Paper.—See Hochstädter's Gun Paper.

Rendrock is said to consist of

Nitro-glycerine	33.4 per cent.
Sodium nitrate	52.8 " "
Sawdust	2.7 " "
Wood fiber	2.4 " "
Charcoal	2.0 " "
Resin	6.7 " "

According to *U. S. Pat.* 138, 841, May 13, 1872, it consists of

Potassium nitrate	40 parts.
Nitro-glycerine	40 "
Wood fiber	13 "
Paraffin	7 "

Drinker's *Explos. Comps.*, pp. 88, 101.

Reveley's White Gunpowder consists of

Potassium chlorate	48 parts.
Ferrocyanide of potassium	29 "
Finest loaf-sugar	23 "

Drinker's *Explos Comps.*, p. 61.

Rhexite is made in five grades, Nos. 1 to 5.

	No. 1.
Nitro-glycerine	64 per cent.
Potassium nitrate	18 " "
Wood powder	7 " "
Wood mould	11 " "

Dingl. Polyt. Jr. 255, 325

Roburite is a mixture of ammonium nitrate and well purified chlorinated dinitro benzene. Thrown into the fire it burns with a quiet, light flame. It is principally used in coal mining. ENGINEERING NEWS, 18, 341; *Chem. Ztg.* 11, 538; *Jour Soc. Chem. Indust.* 6,561; *Ibid*, 7, 342, 401; 12th *Ann. Rep. H. M. Inspec. Explos. Eng. and Min. Jr.* Dec. 3, 1887.

Romite.—The composition of this explosive is unknown. *Eng. and Min Jr.*, July 11, 1885.

Safety Powder of Courtielle, manufactured by the Triumph Safety Powder Co., of Baltimore, Md., consists of

Sodium Nitrate	70 to 60 parts
Sulphur	10 to 12 "
Charcoal	7 to 10 "
Peat and Hard Coal	9 to 12 "
Metallic Sulphates	2 to 4 "
Oleaginous matter	1 to 2 "

U. S. Pat. 167, 503, Sept. 7, 1875; Drinker, *Explos. Comps.*, p. 103.

Salite, of Bergenstrom, is a mixture of nitro-glycerine and urea nitrate.

Saxifragine, [Poudre Barytique] consists of

Barium nitrate	76 parts
Charcoal	22 "
Potassium nitrate	2 "

Ecl. Eng., 9, 335; Wagner's *Chem. Tech*, p. 154.

Schanewegs Explosive is made in two varieties; that containing

Dinitro-naphthaline	218 parts
Ammonium nitrate	730 "

requires a very powerful detonator, while that consisting of

Dinitro Benzene	2 parts
Ammonium nitrate	5 "

requires less powerful detonators. *Eng. Pat.* 6, 664, May 18, 1886; *Jour. Soc. Chem. Indust.* 5, 679; ENGINEERING NEWS, 17, pp. 175, 279.

Schultze's Wood Gunpowder.—See Gun Sawdust.

Schultze's Improved Gunpowder for sporting purpose consists of

Nitrified tar, colophony, turpentine, or turpentine oil	12 parts.
Pyroxyline	60 to 80 "
Barium nitrate	60 to 80 "
Potassium nitrate	8 to 10 "

The grain of the finished powder may be coated with paraffin, resin, or collodion.

Rifle powder has the following composition:

Nitrified tar, etc., as above	10 parts.
Pyroxyline	280 to 300 "
Barium nitrate	100 to 120 "
Potassium nitrate	40 to 50 "
Sulphur	40 "

Explosives for use in blasting are prepared by increasing the amount of pyroxyline. *Eng. Pat.*, 15, 129, Dec. 9, 1885; *Jour. Soc. Chem. Indust.*, 5, 679; *Ibid.*, 7, 401.

Sebastin was invented by A. BECKMANN in 1872 and consists of

	No. 1.	No. 2.
Nitro-glycerine	78 parts.	68 parts.
Wood charcoal	14 "	20 "
Potassium nitrate	8 "	12 "

This powder was afterward improved and called New Sebastin. The peculiarity of this powder is not in the composition but in the nature of the charcoal, which has great absorbing power. *Ann. Cycl.*, 1885, p. 344; *Chem. Tech. Ztg.*, 1887.

Securité.—See Schoenweg's Explosive.

Selenitic Powder is nitro-glycerine absorbed by plaster of Paris. *U. S. Pat.*, 93,752, Aug. 17, 1869; Drinker, *Tun.*, p. 86; do., *Explos. Comps.*, p. 100.

Seranim is composed of nitro-glycerine, ammonium nitrate, sawdust, benzene or creosote, and, in some cases, alcohol. *Chem. Tech. Ztg.*, 1887; *O. P. and D. Rep.*, Apr. 6, 1887.

It is also said (*Watt's Dict. of Chem.*, 8, pt. 1, p. 766) that it consists of potassium chlorate and nitro-glycerine.

Silestite is composed of:

Potassium chlorate	60 parts.
Antimony pentasulphide	10 "
Sugar	30 "

Jour. Soc. Chem. Indust., 7, 342; *Dingl. Polyt. Jour.*, 267 419-428.

Silotvaar (Silatvor, Tsilotvor) is said to be nothing but pure nitro-cellulose, obtained by nitrating wood fibre. It is said to have been a complete failure in practice. *Eng. and Min. Jour.*, Nov. 27, 1886; *Ibid.*, Dec. 31, 1887; *Chem. News*, Oct. 7, 1887; *Jour. Soc. Chem. Indust.*, 7, 342.

Sjoberg's Explosive. Ammonium nitrate is mixed with a melted purified solid hydrocarbon, and is gelantinized with a liquid hydrocarbon, or with one or more melted hydrocarbons. The solid hydrocarbon used is naphthaline, paraffin, or the like; the liquid purified paraffin or astral oil. In order to facilitate the explosion and to increase the explosive power some potassium chlorate is added, either before or after gelantinization. *Eng. and Min. Jour.*, Dec. 17, 1887,

Sprengel's Explosive Mixtures. *Jour. Soc. Chem. Indust.*, 2, 312; *Ibid.*, 5, 349.

Sundstroem's Powder is an explosive containing nitro-naphthaline.

Titan is vegetable fibre rendered explosive by treating it with acids. *U. S. Pat.*, 145, 403; Dec. 9, 1873; Drinker, *Explos. Comps.*, p. 102.

Titanite consists of:

Nitro-glycerine	40 to 48 per cent.
Cellulose	10 to 16 "
Potassium nitrate	34 to 24 "
Sulphur	2 "
Charcoal	10 "

Tonite is composed of:

Gun cotton	52.5 per cent.
Barium nitrate	47.5 "

Ecl. Eng., 19, 321; *Ibid.*, 18, 561; *Min. and Sci. Press*, Aug. 27, 1881; *Explos Comps.*, p. 65.

Tschirner's Explosive consists of:

Picric acid	57 parts.
Potassium chlorate	43 "

to which is added 5 per cent. of pulverized rosin. *U. S. Pat.* 232, 381, Sept. 21, 1880; Drinker, *Explos. Comps.*, p. 107.

Turpin's Explosive consists of a mixture of potassium chlorate, tar, and charcoal more or less finely granulated. It is exceedingly sensitive to friction. *Engineer* June, 4, 1886.

Tutonite is said to be a potassium chlorate powder *Ecl Eng.*, 9. 335.

Uchatius White Powder is another name for nitro-starch.

Vigorite.—It is said that the following compound is sold in the United States under this name:

Potassium chlorate	17.50 per cent.
Potassium nitrate	18.75 " "
Chalk	8.75 " "
Sawdust	11.25 " "
Nitro-glycerine	43.75 " "

Ann. Cycl., 1885, p. 345.

Vingtum Powder.—The composition of this explosive is unknown.

Vitrite is made in two grades. No 1 consists of nitro-glycerine, potassium nitrate, and charcoal. No. 2 has the potassium nitrate replaced by sodium nitrate. *Proc. Nav. Inst.*, 11, 89.

Volkmann's Wood Powder, (Collodin and Nitropglin,) consists of sawdust, potassium ferrocyanide, and sodium nitrate. *O. P., and D. Rep.*, Apr. 20, 1887; *Chem. Tech. Ztg.*

Vulcan Powder is said to consist of

Nitro-glycerine	32.60 per cent.
Sodium nitrate	49.46 " "
Charcoal	9.65 " "
Sulphur	8.31 " "

Iron Age, Feb. 24, 1887; *Ann. Cycl.*, 1885, p. 345; *Proc. Nav. Inst.*, 12, 423.

In Drinker on *Explosive Compounds*, p. 88, it is given as composed of from 16⅔ to 33⅓ per cent. of nitro-glycerine mixed with mealed gun-powder.

Vulcanite from Jiet is composed of

Potassium nitrate	35 parts
Sodium nitrate	19 "
Sulphur	11 "
Sawdust	9.5 "
Potassium chlorate	9.5 "
Charcoal	6.0 "
Sodium Sulphate	4.25 "
Potassium ferricyanide	2.25 "

Dingl. Poly. Jr., 255, 325.

Wahlenberg's Powder is a nitro-naphthalene compound.

White Gunpowder.—See Reveley's White Gunpowder.

White Dynamite.—See Diller's White Dynamite.

Wood Meal Gelatine consists of ordinary blasting gelatine with the addition of various proportions of wood meal. The tests made on this explosive by her Majesty's Inspectors of Explosives proved highly satisfactory. It has been manufactured very extensively, though, unfortunately, not with entirely satisfactory results. *Engineer*, June 4, 1886; *O., P., and D. Rep.*, July 14, 1886.

Xyloglodine consists of nitrated glycerine-starch, or gylcerine-cellulose, etc. Drinker, *Explos. Comps.*, pp. 87, 101; *U. S. Pat.*, 99,000, Jan'y. 25, 1870.

Xyloidine is nitro-starch.

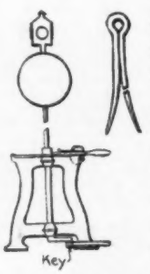
CORRESPONDENCE.

An Accident With a Moral.

CHATAUQUA, N. Y., June 28, 1888.

EDITOR ENGINEERING NEWS:

Having had the misfortune to be in the serious accident to the fast Chicago Express, on the New York, Lake Erie & Western Railroad, last Saturday, June 23, I enclose a short description of the accident and the condition of the track, as found immediately after its occurrence. I was in the forward end of the day coach, but, aside from a severe shaking up, came out all right.



The accident seems to have been due to fast running on a poor track, or to an intentionally misplaced switch. The train was 1¾ hours late, and was running at a rate of at least 50 miles an hour. The road at this point is single track and is over-crowded with freight. The accident in question occurred at a side track on a curve to the right, about two miles west of the town of Cuba.

The engine kept the main track with the baggage car, the smoker, day coach, and three sleepers taking the side track. The engine ran up a bank on the left, the switch being on the right of the main track, and rolled completely over, landing bottom upwards on the side track.

The baggage car, smoker, and day coach were found side by side, at right angles to the track, the day coach being thrown end foremost down an embankment of about 20 ft. The three sleepers were derailed, the forward one having crushed through the ends of the day coach and smoker, but otherwise they were not seriously damaged. The engineer and fireman were found under the tender, the former having been instantly killed, and the latter probably fatally injured.

The escape of the passengers in the day coach and smoker seems to have been miraculous, no one being fatally hurt.

The switch was found locked, but the key that attaches the lever arm to the connecting rod was found on the switch tie, and broken in such a way that it could not have been removed by any jar or force that the train could have exerted. The absence of the key allowed the connecting rod to drop down, leaving the switch in position, but free to move at the slightest jar.

The track was found undisturbed up to the first rail beyond the frog, the end of this rail, for about 3 ft., was found broken in small pieces, but with no apparent flaws. The track and ties for the next 300 ft., on both the main line and switch, were badly twisted and torn out of place.

The accident seems to have been distinguished for a lack of consideration for the welfare of the passengers by the railroad officials. Ladies were ungraciously forbidden seats in the sleepers by the Pullman officials until forced to by threats of reports being sent to headquarters. Although the accident occurred at a comparatively short distance from Salamanca no attempt was made to transfer the passengers around the wreck for seven hours, and then no chance was given for obtaining any refreshments until 5 o'clock in the afternoon, many of the passengers having had scarcely anything to eat since the night before.

C. E.

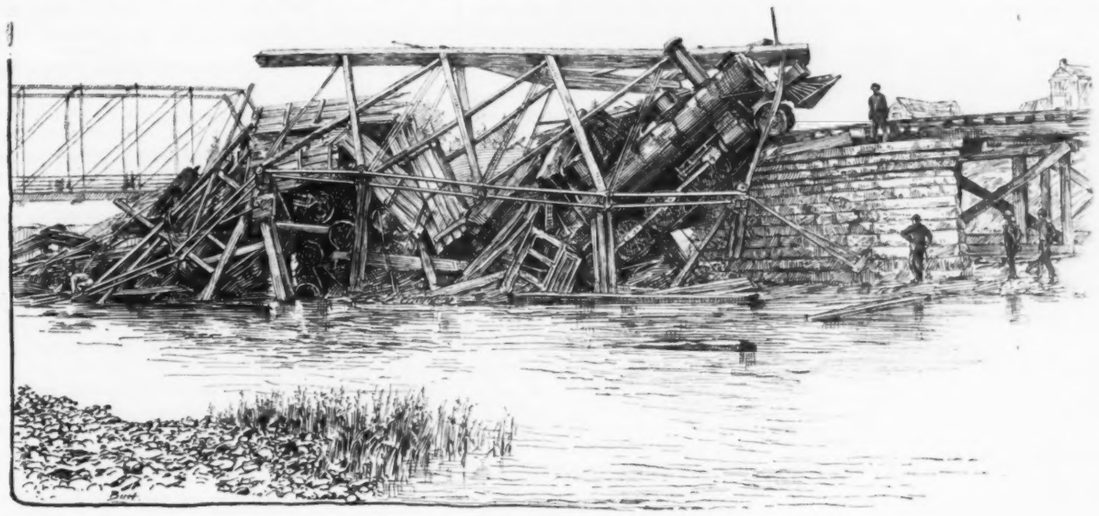
[The split key may have been broken either by accident or design, but in either case the event points a moral, that it should not be possible to detach the connecting rod from the switch stand so easily.—ED. ENG. NEWS.]

A Good Bridge in Distress.

ALBANY, N. Y., June 19, 1888.

EDITOR ENGINEERING NEWS:

I enclose herewith a photograph of a good bridge in distress. This bridge was originally built for narrow gauge traffic, but about eight years ago the gauge was changed to the standard without, as far as can be ascertained, making any change in the bridges, and since then this bridge has borne a heavy coal traffic drawn by Consolidation engines like the one in the picture. The bridge was a Howe truss but had an iron lower chord composed of I-bars. It contained twelve panels of 13 ft. each and was reported to have been 19 ft. high. The top chord consisted of four pieces of 5×11 ins. The lower chord varied from two bars 4×⅝ in. in the end panels to four 4×1⅛ in. in the center. The main braces were double and ranged in size from 7×8 ins. at the center to 10×12 ins. at the ends. The tension



A Good Bridge in Distress.

rods were in threes and varied from 1⅛ in. diameter at the center to 2 ins. at the ends. From another photograph in my possession showing the ends of some of these rods they do not appear to be enlarged at the ends for screw threads. If we assume the dead load to have been 1,200 lbs. per ft. and the moving load to have averaged 3,000 lbs. per ft., which is certainly a moderate estimate, the strain in the top chord would have reached nearly 15,000 lbs. per sq. in., in the lower chord from 17,000 to 18,600 lbs. and in the tension rods over 20,000 lbs. per sq. in. If the moving load were more than 3,000 lbs. per ft., as might easily have been the case, these strains would have been exceeded.

I call the bridge a good one, because any bridge must have been good if it stood up under such loads for seven or eight years before it tumbled down.

The officers of the company which owned this bridge swore, year after year, in their annual reports to the State authorities that all their bridges were examined every 30 days, and that these examinations were analytical and made by a competent person. Moreover they also swore that all their bridges and trestles were provided with guard rails, but you will find no trace of any in the photograph.

This bridge was on the Ohio Southern Railway. It used to cross Paint creek at Greenfield, O. It fell down on Nov. 13, last, and killed one of the train men.

Yours truly,

CHAS. F. STOWELL.

Treatises on Irrigation.

PORTLAND, Oregon, June 24, 1888.

EDITOR ENGINEERING NEWS:

Referring to an inquiry (in your issue of June 16, p. 493,) for treatises on irrigation, may I say that no Engineer need go without such works; and very practical books they are too. The best thing I know in English is in the course of Manuals, published by the staff of the Thomasan Civil Engineering College at Roorkee, India, and is No. X., entitled "Irrigation Works". It is very complete, being designed for the East Indian practice. The same institution has published a set of irrigation tracts as follows, No. 1, Memoranda on the Ricefields of Portugal. No. 2 on the Rain water Tanks of Northern Italy; and No. 3 a vocabulary of French and Italian irrigation terms. In addition to these may be mentioned, "Irrigation by Rijbuhas, by Capt. W. E. MORTON. All these may be had of Spon.

If the engineer is familiar with the French language he may find every thing there, that has ever been written on the subject in any language; and will learn that the East Indian works, like those now being published by the State Department of California, are really compilations from French works. Like everything from the hand of French engineers, they are exceedingly practical as well as nicely scientific.

AYMARD on the irrigations of Southern Italy and BUFFOU on Canals of Irrigation, both works published in Paris and fully illustrated in every detail, leave nothing to be desired.

But the most complete thing I have ever seen, and a book of which I have made constant use in the very extensive deserts of Peru, is the work of RAPHAEL PARETO, "*Irrigation et Arrosement des Terres. Traité de l'Emploi des Eaux en Agriculture.*" PARETO, the author, was a corresponding member of the Royal Academy of Agriculture of Turin and the work was published in "Manuel-Roret" forming a part of Roret's Cyclopedia. It is in four parts, comprising 1200 pages or more of text and an extensive atlas. I fancy no question can arise concerning details of irrigation practice and its results, that is not answered in this work of PARETO. I have never met it, and I have had a pretty extensive practice.

While I am on this subject, I want permission to refer to a slur that I thought not called for, which you put on the Engineers of Peru in a late number of the ENGINEERING NEWS. Referring to the subject of great dams, you took occasion to say how the matter would be settled "in Madagascar, Peru and Siam."

I should not write specially for reference to this, because, while I am a member of the Peruvian Corps of Engineers, I am quite certain the gentlemen of that Corps have no need of any defence at my hand. But as the occasion is opportune I will avail myself of it to say, that I have yet to find a more highly accomplished body of men than the Civil Engineers of the National Corps of Peru. Several of them were educated at our own Renssalaer, Sheffield and Lawrence schools and then passed a course at the French Ecole Polytechnique.

As to the question of high dams, I send you a design prepared in 1876 for an irrigation work, with the tables accompanying. In all that has been presented of late on the subject in the columns of your valuable paper, I have seen nothing more comprehensive than is here shown, and a great deal that is extremely elementary.

ENGINEERING NEWS is read in Lima, and a good deal prized there; but an engineer at the head of the School of Mines, who was some years ago, in the Junta Central of the Engineer Corps, wrote me lately "why do you publish so much text-book stuff in your engineering papers, instead of making them records of work done."

I hope I am not churlish, when I say, that the same observation may be made of much of our American Society matter which appears in the Transactions, which thus lose dignity and value for engineers in practice, unless for beginners.

ALFRED F. SEARS. M. Am. Soc. C. E.

[We trust no one but our correspondent imagined that any slur on the engineers concerned was intended in our casual reference to the fact that some of the conditions for the design of dams in "Madagascar, Peru and Siam" were quite different from those which should govern in designing a dam almost in the heart of a great city. We referred only to differences of locality; not of engineering skill.—ED. ENG. NEWS.]

Sloping Courses in Dams.

WINNIPEG, Manitoba, June 27, 1888.

EDITOR ENGINEERING NEWS:

In a dam with a light batter on the back and a good face batter, if the courses were laid up not horizontally, but square to the face batter, what difference would that make in the calculation for sliding on horizontal courses? Good dams have been built this way without any difficulty. After putting in the bottom triangle whose base is the base of the dam the other courses are laid up from the inside on beds perpendicular to the sloping face of the dam, throughout the work. B.

[The accepted best practice is to have no courses at all in dams, and most of them are in more danger of overturning than of sliding, but it would undoubtedly conduce to stability to lay up the courses as suggested, both theoretically and practically. ED. ENG. NEWS.]

The grip of a heavy eight-wheel cable car of the Chicago North Side line caught in a strand of the cable on July 1, and the car, which could not be stopped, dashed into the train ahead of it, made up of two lighter four-wheeled cars. The rear car of the train was thrown from the track and the big car pushing by it, ran into the leader, throwing it fairly across the track. The grip still held to the cable and the cars were carried along the street for two blocks before the cable could be stopped, the big car pushing the other sideways for that distance.

All the cars were filled with passengers, who jumped off as best they could, many escaping by the windows. Two or three were injured, but none seriously.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, July 17. Secy., S. M. Wickersham Penn Building.

Ohio Institute of Mining Engineers.—Summer meeting at Logan, O., July 11, 12, 13 Pres., W. H. Jennings, Columbus; Secy. R. S. Weitzel, Kittanning.

New England Roadmasters' Association. – The 6th, annual meeting will be held at Boston, Mass., August 15, 16. Secy.: W. F. Ellis, Roadmaster, Providence & Worcester R. R., Woonsocket, R. I.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

IN spite of the bitter opposition which any attempt to formally countenance and permit local organizations and meetings of the membership, elsewhere than at New York, seems to excite among some of the members of the American Society of Civil Engineers, the natural tendency to, and need for such organization has been too strong for discouragement, and Cincinnati has taken the lead in the formal organization of such a wheel within a wheel, under the following constitution, which we abridge only by leaving out the numbers of the articles and sections:

NAME.—This organization shall be called the "Cincinnati Association of the American Society of Civil Engineers."

OFFICERS.—The officers shall be a president, secretary and treasurer. The offices of secretary and treasurer may be held by one person. The officers shall be chosen by ballot in the month of April in each year, or as soon thereafter as practicable. A majority of votes cast shall be required to elect. Vacancies for unexpired terms shall be filled by ballot, as soon as practicable. The officers shall perform the duties usually pertaining to their positions, and such other duties as may be assigned them by the Association.

MEMBERS.—Any member of any class of the American Society of Civil Engineers, may become a member of the Cincinnati Association by subscribing his name to the Constitution and paying the stipulated dues. The initiation fee and annual dues shall be of such amounts as shall from time to time be prescribed by the Association.

When the dues of any member shall remain unpaid for the space of three months, the Secretary shall notify him in writing, that unless the same be paid within three months thereafter, his membership will cease. In case such dues shall not be paid pursuant to such notice, and unless the Association otherwise direct, he shall thereupon cease to be a member, nor shall he be eligible to membership again except by ballot. Members unable to attend meetings may vote for officers by letter ballot, and on such questions as the Association may direct.

MEETINGS.—Regular meetings of the Association may be fixed by resolution. Special meetings may be called by the President or by any three members whenever deemed necessary. Five members shall constitute a quorum.

AMENDMENTS.—Amendments may be made to this Constitution after one month's publication to all members, and by the concurrence of at least two-thirds of all the votes cast.

Col. WM. E. MERRILL, U. S. Engineers, is the first President of this organization, and Mr. GEO. B. NICHOLSON, Secretary.

St. Louis has organized less formally a similar organization. In time others will follow suit, and in time such organizations will be encouraged by the constitution of the American Society of Civil Engineers. In the meantime there is necessity to have at Cincinnati as at other places a separate local organization to provide for a few others who cannot or will not join any grade of the American Society. The Cincinnati organization consists of 19 members Am. Soc. C. E., 2 Juniors Am. Soc. C. E., and 18 others, nearly all of whom would probably be eligible and glad to join as Juniors, if that were the only way of joining the local organization. Those who could not or would not, would for the most part be a small loss.

WHEN the Vanderbilt lines and the Pennsylvania keep a firm and conservative position on the rates for through traffic, little attention need be paid to the desultory rate cutting by the minor companies, as the example of the two chief competitors serves to keep them in check. But when the managers of these two trunk lines make no pretence of working in harmony, then a rate war may be expected of no small importance. As in the rate disturbance of last winter, cuts on the dressed beef traffic precipitated the present difficulty. At this writing, rates on dressed beef between Chicago and New York or Boston are down to 26½ cts. per 100 lbs., which is considerably less than half what they were at the beginning of the cutting. The "Soo" line has also entered the lists and has reduced rates between New York and St. Paul by an all rail route to 60 cents per hundred for first class and 20 cts per hundred for sixth class, a rate below any made by the combined lake and rail routes. The absence of the controlling influence of Commissioner FINK in the administration of trunk line affairs seems to be seriously felt.

In the Northwest, matters have assumed a more favorable aspect. The railroad managers became tired of begging for the justice which they have a right to demand and secured an injunction from Judge BREWER, of the United States Court, delaying the putting into effect of the arbitrary list of freight rates prepared by the Iowa State Commissioners until a judicial hearing can be had. It is reported that Gov. LARABEE when he heard of the granting of the injunction, stated that if a flaw was found in the law under which the commission is working, another law will be made. The Iowa grangers are evidently bound to rule or ruin, and at present they seem to be making every effort to do both.

A curious illustration of the fact that the question of railway rates is rather a question of the rivalry between different towns and cities and different sections of the country than it is between the railways and the public, is given by the recent controversy over the right of the railways to disregard the long and short haul clause of the Inter-State Commerce law in making through export rates from Chicago and Western market centers to European ports. The Produce Exchanges and Boards of Trade of New York and other seaboard cities have made a complaint to the Commission that they are discriminated against by the railroads in this way. Minneapolis has now taken the lead in a counter petition asking that the making of special rates for export goods be not discountenanced. The Commercial Exchange of a Northwestern city has formally condemned the Inter-State commerce law *in toto*. When we reflect that the operation of the long and short haul clause, the principal feature, is to prevent railways from making wholesale discriminations in favor of the large cities and against the small centers and agricultural districts, the reason for the opposition is very plain.

THE recent feat of the Pennsylvania shops at Altoona, Pa., in setting up a locomotive in the erecting shop in 17 hours, which we reported last week, has received wide notice from the press, which almost without exception takes the statement that the engine was *erected*, which was the form in which the item was probably given out for publication, to mean that the engine was built from the raw material in that time. It would seem that a very slight acquaintance with technical matters would show the absurdity of such a story, but the ignorance of many most intelligent men on mechanical matters is well known.

We were rather surprised, however, to find one of our contemporaries in the railway field making the same error, while they also ascribe the feat to the Baldwin Locomotive Works instead of the Altoona shops, a clear case of confusion worse confounded. For the instruction and edification of the journal above referred to we would say that the last step in building a locomotive is to carry the boiler, frames, cylinders, driving wheels, cab, pilot, truck and all the various minor appurtenances necessary to the complete machine, each of which, in a large works like those at Altoona, has been finished in another shop, into the erecting shop, where the various parts are put together. If it be thought that it is but a small task to accomplish this feat in 17 hours, we suggest that the doubter visit a locomotive erecting shop or examine carefully a locomotive and notice the multitude of parts, in joining which a certain order must be followed.

THE same journal makes facetious remarks in reference to another floating newspaper "filler" that, "the Union Pacific is putting on a new class of engines with two cabs, one for the boiler and one for the fireman". The tenor of its comment indicates, however, that it is ignorant of the fact that these separate cabs are not put on to promote seclusion and meditation on the part of the enginemen, but are rendered necessary by the peculiar form of the Wooten boiler, which type, with the two cabs, has been in extensive use for a number of years,

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THE great contest as to "English *vs.* American Locomotives," which has been running almost steadily in the English engineering journals for about two years, but which fails to spread further, still continues there, and some very poor and paltry stuff is brought out every now and then, as for example, in the last issue of *Engineering*, where an "Observer" rings the changes on the alleged fact that some American mogul engines ordered for New South Wales, which cost originally the hand-

some sum of $13,000 each (it certainly was a handsome sum, as they cost nothing like that here) have required $2,000 each in repairs within six months!

THE utter absurdity of such statements, as an argument, is so evident that one would hardly expect to find that they would secure either authors, publishers or readers. The American locomotive continues to stagger along under his burdens, and is as well as could be expected, in his native clime; not requiring more than $1,950 worth of general repairs in the first six or eight months of his service, as a general rule, except in the climate of Australia.

IN the interest of the English language, and to keep engineers from appearing ridiculous in the eyes of educated men we feel disposed to urge them to avoid the use of that fine sounding vulgarism "graduation", as a substitute for the simple word which is really meant, "grading". "Grading" is one thing; "graduation" is another and quite a different thing. To use them as synonyms of each other has not a particle of good authority, and probably originated only in a foolish hankering after a more ponderous and polysyllabic word to designate so large a feature of engineering work. It has spread so that now the countenance of some very excellent and able engineers may be pleaded in its favor; and it may be that this sense of the word will yet establish itself as a recognized part of the language, since it is usage, and usage only, which finally decides. But it has certainly not so established itself yet, and the origin of this perversion of the word is so evident, that, until it unmistakably has done so, it ought to be regarded as an odious innovation to be discouraged and not encouraged. The simplest, clearest and best established word which will convey the whole idea sought is always the most really scientific, and the most creditable to the man who uses it. Grading is an art as old as the Pharoahs, to say the least: too old a one to need a bran-new word for it, twice as long as the one which has heretofore answered every purpose.

It may be pleaded in extenuation of this use of the word "graduation" that the word "grading" itself, as a noun, is not in the dictionary, and so recent a feature of the language are the terms of civil engineering, that even the word "grade", as a noun, in the sense of rate of inclination (and of rank or degree as well) is only admitted on sufferance, as a modern innovation. Worcester's Dictionary says:

"Grade, though derived directly from the Ang.o-Saxon *grad* and, through the French, from the Latin *gradus*, of but recent introduction into English." Mr. TODD Edr Johnson's Dict., 1818] says: "This word has been brought forward in some modern pamphlets, but it will hardly be adopted." It has, however, been adopted and used by many respectable authors, and it is now in established and good use."

But, "grade" as a verb is very old, including its participle "grading", and the conversion of a participle into a noun is in accordance with the genius of the language, and can be supported by many examples. The use of the noun "grading", therefore, to include all the various rock and earth excavations and embankments under one term is entirely legitimate, and can be supported by innumerable examples since the introduction of railways, if not earlier ones. Moreover, if a new word had to be coined to represent a new idea, "grading" is the proper one for the purpose. "Graduation" has an established and wholly different signification. We may speak of the graduations of a vernier, or of graduation from a college, but not of the "graduation" of earth or rock without absurdity.

IN hunting through a quaint old book, "An Account of the Liverpool & Manchester Railway, by HENRY BOOTH, Treasurer of the Company", to find an instance of the early use of the word "grading" above spoken of, we did not find it, but did find a delightful example of the weaknesses of our common human nature which we think has escaped notice. Mr. HENRY BOOTH was a student and enlightened man, and it is not as generally known as it should be that he was the original suggester of the multi-tubular boiler which is the *sine qua non* of the locomotive engine. The acceptance and practical application of the suggestions, however, was the work of GEORGE STEPHENSON, and perhaps entitles him to be alone well remembered as the originator of that as well as all other essential details of the locomotive. Mr. STEPHENSON was also the sole owner of the *Rocket* engine, so far as history makes any record, although it is conceivable that Mr. BOOTH may have had some financial interest in the venture of which no record became public. Be this as it may, Mr. BOOTH in his *History* thus records the result of the great locomotive test of Oct. 6-12, 1829.

"The report of the Judges corresponded with the above statement [of the success of the *Rocket* and relative failure of the *Novelty*, *Sans Pareil* and *Perseverance*] and the Directors accordingly awarded the premium *to the writer of this account* [italics ours] and the Messrs. Stephensons, *to whose excellent construction of the machinery I was much indebted for the favourable award of the Umpires.*"

Considering that STEPHENSON had built the first successful locomotive in 1814, and the first to run by adhesion due to weight; had invented the exhaust blast in 1815; had built so many locomotives as to found the great Stepenson Locomotive Works at Newcastle-upon-Tyne in 1824, and various other things, Mr. BOOTH certainly was somewhat indebted for "the excellent construction of the machinery" to "Messrs. Stephensons," as he so handsomely acknowledges. One cannot but smile at such a touch of nature as this self-satisfied statement reveals, and in view of such an absurd attempt to appropriate to himself honor which belongs to others, perhaps Mr. BOOTH has met no harder fate than he deserves in being almost forgotten as the suggester of one important detail of the locomotive.

IT is satisfactory to observe that the English technical papers have "caught on" to the jockeying of brake returns which has been going on for some years in England and is doing much to perpetuate the regrettable confusion of practice in regard to train brakes which still exists in that country. All the companies in that country are obliged to make full returns as to their brakes, and among other things as to their failures in use. *The Engineer* makes these rather amusing comments on some features of these returns.

"The most remarkable feature in the returns as bearing on brake management is the experience of the Midland Railway with triple valves. The Great Eastern and Great Northern Railway companies ran an aggregate of over 10,000,000 miles, without a failure of the triple valve. But the Midland Company ran the Westinghouse brake only 192,172 miles, and the triple valve failed by sticking no less than eighteen times, or once for every 10,700 miles nearly. If similar casualties had occurred at the same rate on the Great Eastern and North Eastern, there would have been 935 triple valve failures recorded: instead of which there is not one. The obvious conclusion is, that not the triple valve is to blame, but the carriage department which has charge of the triple valves: and inasmuch as the failures were all of the same kind, namely, sticking, it seems more than probable that lubrication has been imperfectly or wrongly effected. At all events it seems clear that an appliance which in the hands of one set of men gives constant trouble, while in the hands of others it gives no trouble whatever, is not properly used by the first set: and the soundness of this conclusion is borne out by the fact that the experience of the Midland Company with the Westinghouse brake has always been unique."

The Engineer then cites that on the London, Brighton & South Coast Railway, where the brakes are severely used, there were 72,800,000 movements of the triple valves in six months, and continues:

"The whole distance run by the London, Brighton & South Coast trains was 3,395,942 miles, and the total number of failures was 17, or one in every 199,761 miles. Of the 17 failures only 12 were due to burst hose pipes, from which it seems clear that more care is taken to have good hose on the London and Brighton line than is taken on any other using the Westinghouse brake; and not a single failure of a triple valve is reported. Where in mechanical engineering can we find a parallel to the action of the triple valves on this line, which perform over 72,000,000 of evolutions without a single failure?

The record is certainly a most honorable one, but what it really proves is proved still more forcibly by hundreds of apparently complex machines like the sewing machine or marine steam engines, that complexity or multiplicity of parts is not necessarily an element of special weakness, if each separate part be adequate for its work. Nearly all such machines are objected to in advance for their complexity, but they fail a dozen times from structural weakness, as in the screw-shafts of steamers, where they fail once from difficulties originating in any way from the complexity of the mechanism.

WE are pleased to record that the Kutter fund for the benefit of the widow and children of the late W. R. KUTTER, the eminent hydraulic engineer and author of Kutter's formula, is still growing, and seems to be gaining an increasing impetus, so that we shall hope it will exceed the $1,000 which it was proposed to raise. As one of our corresdents remarks:

"I have noticed that the subscriptions do not come in very fast, and believe it is due to the fact that engineers are too busy to attend to such matters. They do not neglect to do so from any lack of generous impulses."

We fully believe this, but this is now vacation season, and while we trust all our readers are getting ready to enjoy it accordingly, we think it will not hurt them to cut off a few dollars from their contemplated "miscellaneous" vacation expenditures, and devote it to a more urgent if not a better use. The fund now stands as follows:

Previously acknowledged		$382.00
Philip Schopp		5.00
Aug. Johnston		5.00
H. Wehrum		5.00
C. C. Schneider		1.00
Preston Robinson		1.00
C. E. Chittenden		1.00
J. W. Sargent		1.00
E. H. Beckler		5.00
Palmer C. Ricketts		5.
S. G. Knight		
Francis Collingwood		10.00
A. J. Swift		5.00
W. W. Jameson		1.00
Second subscription list of the German American Technical Society of New York.		
Chas. A. Schieren	$25.00	
F. O. Mathiessen	10.00	
L. Portong	5.00	
H. von Nostitz	5.00	
Fred. Thomas	5.00	
Total		50.00
Total received to date		$488.00

IT is extremely difficult to make out what has been the real outcome of the Panama lottery loan, except the general fact that it has been a failure, the aggregate subscriptions as announced by the company being only 40 per cent. of the total amount of the loan; which outcome the lottery and "guarantee" conditions make almost as bad as a dead failure. Past experience warrants a suspicion that the real outcome is worse even than an-

nounced. It is now vaguely given out that the securities which the "lambs" would not touch are now to be taken by a syndicate of bankers! One may easily guess how likely they are to do so except on terms which will leave the canal company tied hand and foot, if not on this loan, then on the next which must shortly be necessary.

The Floods in Mexico.

About 120 miles north of Mexico, or some 30 miles south of Querétaro, there begins a very remarkable district of Mexico, known locally as the Bajio or "flat", which extends unbroken as far as the city of Leon, some 140 miles, including in its length the cities of Celaya, Salamanca, Irapuato, and Silao. With a slight interruption between Leon and Lagos, the same general character of country extends northward from Lagos to the great mining town of Zacatecas, 143 miles, including in its center the city of Aguas Calientes, or Hot Springs. This latter district is not included in the local term Bajio, but all that we have to say applies equally to it, in somewhat less degree.

The Bajio is the most fertile and most densely populated area of Mexico, and the Mexican Central Railway runs nearly through its center for its whole length. It is to the eye a vast plain, as its name implies, 20 to 40 miles wide for the most part, bounded by high mountains on both sides; but it is not really a plain, except near its center, having almost everywhere a considerable slope downward from the mountains toward the rivers flowing nearly in its center, which drain it. It had a considerable Spanish population half a century before there was a single white resident in what is now the United States, and every one of the cities named was founded in that half century.

As in the rest of Mexico, all but a few of the most stately edifices are built of *adobe*, or clay mixed with straw and baked in the sand, a cheap, durable and excellent material where there are no frosts, and which succumbs to but one other enemy, water. Even by water in the form of rain it is very little affected, resisting ordinary storms for centuries, when protected by a roof. By adding a coat of plaster on the outside face, as is done for almost all houses except the poorest, the surface is preserved almost wholly intact for indefinite decades. But when completely immersed and soaked in water, the bricks very quickly lose all coherence, and revert into their original mud.

This is precisely what has happened in the late terrible floods at Leon and Silao, which appear to have cost the lives of fully 1500 people, and perhaps twice as many. Over 1,000 bodies have been recovered, and the stench arising from those which have not been recovered, as well as from drowned animals, is described as pervading the whole air. From the rather meagre descriptions which have as yet reached us we quote as follows:

"During the past ten days (June 16-26) the table lands between Mexico and Zacatecas have been visited by unprecedented rains. Every mountain rivulet along the Mexican Central Railway for more than 200 miles has been converted into a destructive torrent,and the valleys present the appearance of lakes. Many cities and towns have been inundated and Leon and Silao have been partly destroyed.

The first intimation received in Mexico of the disaster in the north was a telegram from Silao dated the 18th inst. It said: "It commenced raining heavily here yesterday afternoon, and continued all night, raising the Silao river out of its banks, breaking at the north end of the town and passing through the streets with irresistible force and volume. Most houses here being of adobe, as soon as they were saturated with water they began to fall. About 325 houses have been destroyed. The station buildings are occupied by homeless people, who are unable to obtain anything to eat except watermelons and fruit found floating in the water. The rain has been general and the whole country around Silao is flooded. Several dykes have given way. It still continues raining."

On the 20th it was learned that the floods had been more destructive in Leon than in Silao. On Monday, the 18th, the river broke over its dykes, and notwithstanding all efforts to check its course, it made rapid headway and finally flooded the city. As the rain fell the river rose rapidly, its volume of water flowing into the town, gradually wearing away the foundations of buildings, which commenced to fall as night came on.

Monday night brought to that city one of the most terrible of scenes. People believing themselves secure from the flood went to bed in those parts of the town where the water had not found its way. The steady downfall of rain, with the extensive water shed of the outlying country, increased the flow of the river, and rapidly extended its channel until over half of Leon was under water. Houses tumbled in rapidly, having been worn away by the water, and terrible loss of life began. As the buildings fell the unfortunate sleepers were either crushed to death or drowned.

One whole night of terror followed. Men, women, and children fled to the streets in their night clothes, some to find shelter on higher ground and others to be swept away by the flood. On Tuesday morning rain was still falling and there was no perceptible decrease in the stream of water. A mammoth lake extended its length and breadth to all points of the compass. Its monotonous appearance was occasionally broken by half-submerged houses and high lands cropping above its anything but placid surface. The town had a wrecked look. Where the houses had stood the night previous, water was surging in its flight to lower grounds.

The loss of life up to this writing had reached into hundreds, but the threatening danger left little time for sorrow, and the prevailing sentiment was fear for the future. All night it poured, until Wednesday morning, June 20, saw the lake surrounding the city undiminished in size, with steady rain disturbing its surface. In the afternoon, however, it ceased raining and the waters began to recede. The people recovered from their fright, though water was still covering a part of the city. There is a strong stench from heaps of rubbish that once formed houses, and there must be bodies buried under them. There are also bodies still floating in the water. One hundred and eleven bodies have been recovered without moving any ruins of houses, wherein are supposed to be hundreds of bodies buried. The number of destroyed houses is estimated at 2,000 and the loss at $2,000,000.

Many other towns have been badly damaged, but loss of life is only reported from Silao and Leon. The Mexican Central has suffered very severely. Several washouts occurred between Aguas Calientes and Leon, but they have now been repaired, and trains are running from El Paso as far south as Leon.

The last reports from Leon are heart-rending. The whole population are busily working into the ruins of the fallen houses. Nearly everybody has lost relations or friends, and those who have not have seen their earthly possessions disappear in a night.

The estimates of loss of life and property given are the smallest reported, and certainly within the bounds of truth. The very last statement, just received, places the number of houses destroyed in Leon at 2,224. The total loss of life is at least 1,500, about 1,000 bodies having been recovered."

It will be seen that if any such disaster as this were on record at any point in the Bajio (and some of the towns were larger 200 years ago than now) there would be likely to be some tradition of it which would have reached the knowledge of the engineers building the railway, or have been referred to in the dispatches from Mexico. When even the memory of the oldest inhabitant is so unreliable, it is hard to assert with confidence that anything may not have happened within three centuries, but if anything may be so declared, it is that nothing in any way approaching this disaster has ever occurred in that region. No knowledge that any single house in all thees towns was ever so flooded with water as to be destroyed, came to the knowledge of any of the constructing engineers, as we are in a position to assert with some confidence; nor do we believe that such an event ever did happen, unless on a very small scale at some specially low point. As for any general flooding of a town, it seems quite out of the question that such an event can have happened before. But this is not the only great storm which has recently happened in that region. There have been a number of other heavy storms since the construction of the railway which have been popularly regarded as the "greatest ever known" and which have been quite generally suspected to be in some way caused by the railway; in fact, some prejudice against the railway among the "peons" was created by this very fact. Certain it is that a very large part of the railway through this region, and a still larger part of its structures, have been washed away at one time or another in the five years since the railway was opened. In part, this must certainly be ascribed to the errors of judgment in planning the structures which seem almost unavoidable. Without excessive allowance at all the structures, it seems inevitable that a certain fraction of them should prove to have too small openings, and this is especially true in a new and unfamiliar climate.

But after making all allowances for these sources of error, it was difficult, even before this last great storm, to resist the conclusion that the railway had in some way had some effect upon the railfall, and it is still more difficult now. What this effect may be, if any, or how it comes about, we cannot undertake to say, and since there must always have been in every century, or three or ten centuries, some one storm greater than all others, which may come at any time, it is certainly not impossible that this last storm may be merely one of that class, but it is at least a very curious coincidence that it should have held back 300 years and more to come at last within 5 years after the opening of a railway, and within 2 or 3 years of several other unusually heavy storms. As such, we record the fact, to be considered with other circumstantial evidence, as it arises, such as that we noted last week in commenting on the gradual conversion of the "Great American Desert" into farming land.

It should be added that the shape of this vast "Bajio"—a plain of considerable and gradually increasing slope ending at last in steep mountain slopes, is such as to make it peculiarly liable to great floods. Its spoon-shaped form gives very nearly that cycloidal descent which theory would require to insure that a particle falling on it at any point should reach a given point in the bottom of the valley at the same time, so that the tendency is to deliver the entire water-fall on hundreds of square miles at the points in the center of the valley where the towns are, at almost the same moment of time, necessarily producing great floods if the fall be great. It is this immense effect of the *form* of the water shed on the maximum discharge which makes us distrust all formulæ which base culvert sections only on the area drained, regardless of its form. There is probably no place on this continent where this effect is illustrated on so immense a scale as in this very Bajio. Leon and Silao, which suffered worst, are each on wide plains, near the throats of great spoon-shaped areas which are bounded on all sides by high mountains. Rain-fall and area being equal, the maximum flood discharge from such a basin is probably five times as much as if it were a plane or more irregular, and ten or twenty times as much as if the surface were ever so little convex. The very fact which lulls the mind into a false security at Leon and Silao, the vast regular sloping plains which head far up in the distant mountains; is really their greatest source of danger. They give body and volume to the torrents to which the mountain drainage gives velocity; or furnish a frictionless bed in the lower part over which the rain-fall of the upper water-shed may come down all together, as theory requires.

The Metric System in Practical Work.

For reasons that we noted last week we fear there is no great prospect that the metric system will soon, if ever, come into use in this country. It is a vastly more serious business to introduce a wholly new system of weights and measures in great manufacturing and industrial countries like England and the United States than in any of the nations of Continental Europe, and still more in any of the long list of minor countries which seem so much more impressive when merely enumerated to show the progress of the system than they do when the countries are weighed instead of counted. Nevertheless, since the Germans have adopted the system in despite of national prejudice, the universal adoption of metric weights and measures is certainly a future possibility, and this country would undoubtedly gain a certain trade advantage with other nations, should it do so before England. Therefore, the results of actual experience in a sudden and complete change from using American measures exclusively to using metric measures exclusively will no doubt have a certain interest.

The first thing which impresses one strongly in such a change is that, with a metric rule in one's pocket, one is armed for all kinds of uses for which many different scales and measures are required in our practice. Our architects' scales and engineers' scales resemble each other only in being so many inches long, and are in no way interchangeable in practical work, as every draughtsman knows. The common 2-ft. pocket rule resembles neither, and only with great inconvenience can be used as a substitute in an emergency. Neither is the 2-ft. pocket rule capable of use as an impromptu leveling rod, since its graduations are in inches instead of tenths. Neither has it direct relation to the fractions of the 66-ft. chain. The very conception of what are called "natural scales" is an unfamiliar one to most Americans and Englishmen. They know, but do not practically realize, that from drawings or maps made under the metric system dimensions in inches may be read off by an inch-rule or distances in feet by a foot-rule, as easily as if the drawing had been originally made in inches or feet.

When driven to use the metric units, this soon becomes practically familiar. In architectural and mechanical drawings and large plans, instead of our preposterous scales of 1 in., ½ in., ¾ in., ¼ in. and what not, to the foot, the only scales used may be said to be, full size, and ½, ¼, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, $\frac{1}{50}$ and $\frac{1}{100}$ full size. For all these, the common metric graduations are readily used, and special graduations are made only as a slight additional convenience for constant drafting work. For our usual American platting scales of 10, 20, 30, 40, 50, 60 ft. per in., or the same scales multiplied by 10, (these scales amounting to $\frac{1}{120}$, $\frac{1}{240}$, $\frac{1}{360}$, $\frac{1}{480}$, $\frac{1}{600}$, $\frac{1}{720}$ of full size) the usual metric equivalents, and an ample variety for all practical purposes, are $\frac{1}{100}$, $\frac{1}{200}$, $\frac{1}{500}$, $\frac{1}{1000}$, $\frac{1}{2000}$, $\frac{1}{5000}$ (the usual railway mapping scale, almost identical with 400 ft. per in. or $\frac{1}{4800}$) $\frac{1}{10}$ $\frac{1}{000}$. etc. Without much inconvenience $\frac{1}{300}$, $\frac{1}{400}$, $\frac{1}{600}$, $\frac{1}{800}$, etc., may be used, but practically they are not; as they would not be with us except that our system being all arbitrary anyway, a little more or less of it does not matter if any occasional convenience in bringing the drawing to a certain size is thereby gained.

The question then arises as to the intrinsic convenience of the unit; and this is most important chiefly as to measures of length, since they are more used than all other units. For every kind of architectural, mechanical and engineering drawing or construction in which few of the dimensions exceed 5 or 6 ft. there can be no reasonable question whatever that the metric system is immensely more convenient, especially for the uneducated, for the reason that no decimal points are required, nor use of vulgar fractions. A millimeter is almost exactly $\frac{1}{25}$ in. (25 mm. = 0.98426 in.) which is as small a subdivision as is often used. By universal custom and agreement, therefore, understood throughout the civilized world, a dimension marked 57 on such a drawing means 57 m.m. or about 2.28 ($2\frac{2}{3}$) in., 500 means half a meter, 2753 means 2.753 m., a distance of about 68.9 ins., and so on. By adding occasionally the single fraction ½, we get dimensions down to $\frac{1}{50}$ in. Finer work than this implies specially skilled workmen, and for them (as at all our American watch factories) decimals of a millimeter gives equally convenient minute units.

American blacksmiths, carpenters and masons are probably quite as intelligent as Mexican, and it is a fact that the latter use this system almost at once, with great ease, and greatly prefer it. We have no doubt that its corresponding use here would save a host of blunders both by draftsmen and mechanics.

Practice has now established how the metric system can best be adapted to American methods of engineering surveying. The unit of measure is the chain of 20 metres, (65.62 ft. or about ½ of 1 per cent. less than the Gunter's chain of 66 ft.) and the "station" is 10 metres, so that in staking out a line on the ground the stakes are marked 2, 4, 6, 8, 10, 12, instead of 1, 2, 3, 4, 5, 6. This will strike those unaccustomed to it as awkward, but it is not, and has the great advantages that whenever the ground becomes rough, the curve sharp, the material bad, or the vegetation dense, we can at once put in stakes or take levels only half as far apart as usual, for any desired distance, without the use of pluses either in the field or in the notes. In practice this is decidedly convenient.

The change back again from the chain of 100 ft. to the chain of 66 ft., from which we have just escaped (but which is still used by Englishmen) probably strikes all American engineers at first, who are accustomed only to the 100 ft. chain, as a distinct retrogression.

From a large experience in the use of both standards in all kinds of country, and with a strong original feeling to the contrary, we assert that there is no foundation whatever for this feeling; that the only merit of the 100 ft. chain as a unit (a great and sufficient one under the foot standard) is that it is one hundred times the linear unit instead of 66 times; that it is too long for the most efficient work, and that more and better work will be done in any kind of country with the shorter chain. In country at all rough this will not be questioned. The inconvenience of handling the longer chain is likewise evident in timber, underbrush, and through swamps adn crops. In flatter country, where the grass grows at all high, more time is wasted thrice over in hunting stakes afterwards than it would take to set them nearer together in the first place. Unless the ground is very flat, 100 ft. apart is too much for accurate cross-sectioning. Only on the vast treeless and almost grassless plains of the "Great American Desert" does a 100-ft. chain have an advantage over a 20-metre chain, and then a 50 metre, or 5 station chain, (165 ft.) offers a very desirable compromise. Under no conditions, therefore, is a 100 ft. chain as convenient and accurate for practical work as a 20-metre chain.

For curve running it does not make the slighest difference what system is used. All our tables for the foot unit apply quite sufficiently well without change to metric units also. In nothing is the confusing effect of working with irrational units more conspicuous than in the difficulty most engineers have in seeing this practically. The common tables purporting to give radii in "feet" for certain degrees of curve are not really for feet especially. They give the radius in any unit for the curve in which a chord of 100 such units subtends a given central angle. Accordingly, if 5,730 ft. be the radius of a 1° curve when working with a 100-ft. chain, 5,730 decimeters is the radius of a 1° curve for a chain 100 decimeters or 10 metres long, and 573 × 2 metres (1,146) for a 1° curve with a chain 20 metres long. Fixing 1,146 in the mind as 5,730 is fixed in foot work, we determine any radius at once by dividing that by the degree of the curve; or we determine it from a table, in metres, by looking out the radius for half the degree of curve from a foot table and pointing off one more decimal.

As the radius is only required for mapping and a few field calculations this difference amounts to nothing. In running curves, the full stations being only 32.8 ft. apart we rarely require to use pluses at all, and still more rarely anything finer than + 50, making the field work rather simpler. To compare the degrees of metric with foot curves we must increase the latter 50 per cent., a 3° foot curve being about a 2° metric curve.

Great confusion was caused in Mexico by not following at first the rules here laid down. The use of the metric system being obligatory, surveys were started first with 30 metre chains, to come as near to the divinely given 100 ft. chain as possible. That being found to be too absurdly inconvenient, 25 metre chains were used, which are only one degree less awkward, and only toward the end was the true system of 20 metre chains and 10 metre stations understood. The metric profile paper is ruled in millimetre squares (25 per inch each way) each fifth line heavier, and each tenth and fiftieth still heavier. The established horizontal scale being $\frac{1}{5000}$ (416.67 ft. per in.) each millimetre represents 5 metres or half a station horizontally and usually 0.4 m. vertically (33.33 ft. per in.). In smooth country 0.2 m., or twice this scale is often used. These scales are convenient in practice, and the fact that the profile paper is the same either way and can be used for cross-section or sketching is a great advantage.

For leveling, it may with more reason be claimed that the foot unit has a slight advantage. Readings to tenths of a foot for ground levels, to hundredths for benches and turning points in rough railroad work, and to thousands for accurate leveling, are about the right thing. The nearest decimeter (0.33 ft.) is rather too coarse for any kind of surface level, and the centimeter (0.04) decidedly too coarse for any kind of a turning point, and too fine for surface levels. On the other hand the millimeter (0.004 ft.) is about as fine a reading as it is at all practicable or sensible to take for turning points in ordinary leveling, in which the sights are not measured and the instrument not shaded by an umbrella. Without such precautions it is an absurdity to read to thousandths of a foot; the readings cannot be relied on, nor taken independently, within two or three thousandths. Hundredths only are rather coarse, yet, of the two, are the best practice for all railroad work, and as errors are compensatory, result in quite as good work as attempted reading to thousands. Millimeters afford just the right compromise.

For ground readings and slope stake work, however, as stated, decimeters are clearly too coarse and centimeters too fine. The usual compromise is to read to decimeters only on

preliminary surveys, which answers every practical purpose, and to read to centimeters in staking out work. This is needlessly fine, but it suits some people all the better, and does not involve much more work. The best rod is 4 or 5 metres long with the decimeters numbered from 1 to 40 or 50. So far as graduations are concerned there is no difference in convenience; for some sights the foot graduations being better, and for others the metre. The occasional inconvenience of not being able to read the foot mark in close sights is saved.

For executing and computing the work the metric system is much the most convenient. The last is evident because conversion into cubic yards is saved. The first was very conspicuous in one respect on Mexican work. Much of it was done by task work, from borrow pits at the side. The greenest foreman could measure off so many metres long, so many wide, and so many deep; and the laborers at 37½ cts. a day soon learned to do so likewise, nearly enough to be sure they were not being cheated. Cubic yards would have been a sealed book to both foreman and workman.

The best roadbeds for single track work are 6 metres in cut (20 ft.) and 4.4 metres in fill, which are conveniently even. To appreciate the contrast in simplicity between the two systems, let any one try to figure out in his head how many cubic yards there are in a mile of work averaging 6 ft. cut, and then, how many there are in a kilometer of 2 metre work. The one is easy, the other almost impossible.

The metric system has a needlessly complicated look as studied from books because of the number of successive units. The system in practice consists simply of—1,000 mm. =1 metre; 1,000 m.=1 kilo. (kilometer)—just as our real currency is simply cts.=$1, the units of mills, dimes and eagles being quietly dropped. Similarly, our American measures of length are only 12 ins.=1 ft; 5,280 ft.=1 mile; yards, rods and furlongs being dropped from all engineering work, although still retained in England. Similarly, our real weight measures are only 16 oz.=1 lb. 2,000 lbs.=1 ton, and the real metric weights 1,000 grammes =1 kilo. (kilogramme, 22 lbs.); 1,000 kilos.= 1 tonne (2,204 lbs.). Both kilometer and kilogramme are in practice abbreviated into kilo., with no real danger of confusion.

But it is in compound units and in square and cubic measures, that the advantage of using metric measures in engineering work is most conspicuous. The fact once grasped that a liter of water is about 1 quart, weighs a kilo., and is $\frac{1}{1000}$ of a cubic metre in volume, and we have only to add to our memory the specific gravities of the leading engineering materials, to be armed and equipped for almost any form of engineering calculation without further reference to tables. How great this advantage is only dawns on one gradually as he becomes familiar with the units. We are accustomed to burden our minds with a variety of arbitrary constants, only a few of which we use enough to have them at our fingers' ends, such as the weight of water, sand, granite, iron, brass, lead and what not, per cubic inch, foot and yard, per square inch a foot or yard long, per square foot one inch thick, per cylindrical inch, etc, etc. So little do we use specific gravities that few engineers have more than one or two of them in their memory. The good Continental engineer early learns them for all leading engineering materials and never forgets them. How many gallons per hour, and how many tons, does an inch of rainfall on an acre represent; what cross section will be required to carry it off with a velocity of 8 ft. per second? Let the reader compute these examples, and then compare the work with the computation of how many litres per hour a centimeter of rainfall on a hectare represents, and what cross-section will be required to carry it off at 2 m. per sec.

Both for such computations and for such use as he may find necessary in reading, the reader will do well to reduce the whole metric system mentally to its only real constituents for practical work, which are:

Length. 1,000 mm.=1 m.; 1,000 m.,=1 kilo. (0.62 mile
10,000 sq. m. = 1 hectare (2.47 acres)
Areas. 10,000 sq. cm.=1 sq. m. (10.76 sq. ft.)
Volumes. 1,000 cu. cm. =1 litre (qt.); 1,000 litres=1 cu. m.
Weight. 1,000 grammes (cu. cm. of water) = 1 kilo. (2.2 lbs. 1,000 cu. cm. of water); 1,000 kilos. = 1 tonne (2,204 lbs., 1 cu. m. of water).

Discarding all other values from the mind, as we do dimes, eagles, furlongs, quarters and what not, we need only specific gravities to have whatever constants we like at our immediate command.

We are convinced that it would greatly aid the acquirement and retention of knowledge, and prevent many mistakes in the shop, field and office as well, were our weights and measures thus simplified, and were the change once made for five or ten years, no one would for a moment wish to return to the old system. We recognize that the obstacles in the way of any such change are very great. A law making metric measures the official ones after 1900, or some still later date, would afford the best chance of the introduction of the system with minimum friction, but we have little expectation of the passage of even so moderate a law. That it would be really for the good of the country to do so, we cannot question.

PERSONAL.

JOHN F. NEWHOUSE has been appointed Master Mechanic of the Louisville Southern Railway.

F. E. SMITH has resigned his position as Superintendent of Water-Works at Sterling, Ill.

The office of the Gloucester Iron Works has been removed from 6 N. 7th St. to 61 and 63 Bullitt Building, 131 So. 4th St., Philadelphia, Pa.

JOHN SCOTT, formerly President of the N.O. & T. P. R. R., has been made President of the Colorado Midland Railway.

W. H. TRUESDALE, Vice-President of the Minneapolis & St. Louis Railroad, has been appointed receiver of the Minneapolis & St. Louis Railroad Co.

JOHN H. HORNBY has been appointed General Superintendent of the Fort Worth & Rio Grande Railroad, vice O. B. COLTON, resigned.

ROLAND GIBSON HAZARD, the noted financier, mathematician and metaphysician, died suddenly at his home, in Peacedale, R. I., on June 25, aged 86 years.

C. K. WILBER has been appointed Acting Western Passenger Agent of the Lake Shore & Michigan Southern Railway Co. vice F. I. WHITNEY, resigned. F. M. BYRON has been appointed City Passenger Agent of the Lake Shore in place of C. K. WILBER, promoted.

SAMUEL SPENCER, President of the Baltimore & Ohio Railroad, at his own request was, June 28, relieved as co-receiver of the Maryland Central Railroad Co., and the entire responsibility now rests upon WILLIAM GILMORE.

Assistant Superintendent F. W. Dunn, of the South and North Alabama Divisions of the Louisville & Nashville Railroad, with office at Birmingham, has presented to the general officers his resignation, to take effect July 4.

E. W. WESTERFIELD has been appointed Superintendent and General Freight Agent of the Natchitoches Railroad, with headquarters at Natchitoches, La.

J. H. DECKER, Secretary of the American Water-Works Association and for the past 8 years Engineer and Superintendent of the Water and Gas Companies at Hannibal, Mo., is open to engagement as Superintendent or Manager, or as Engineer of Construction, in either Water or Gas Supply. His long experience in all branches of the profession fit him for any work. He may be addressed at Hannibal, Mo.

FRANK THOMPSON was elected First Vice-President of the Pennsylvania Railroad at a meeting of the Board of Directors, held June 27. He will probably retain the immediate charge of the freight and passenger departments, at the head of which he has been since 1882.

JAMES MURPHY, formerly Chief Clerk to B. F. MITCHELL, General Freight Agent of the Chesapeake, Ohio & Southwestern Railway, has been General Freight and Passenger Agent of the Ohio Valley Railroad, vice W. B. HALSTEAD, resigned.

Hon. WILLIAM L. BANCROFT, who has been appointed Superintendent of the United States Railway Mail Service, has been successively printer, editor and railroad president. He was the active spirit in organizing the Chicago & Grand Trunk Railway, was its first President, and operated the road for many years.

Nicaragua Canal Surveys.

The following are the parts of general interest in a report by Chief Engineer MENOCAL, dated Rivas, June 6, 1888, of the main results of the surveys, which were then on the point of conclusion:

The location of the lower route was completed June 6 from Ochoa to Greytown, except some local examinations and additional borings which Mr. PEARY had directed to be made. Mr. COVODE, with one assistant, was taking cross sections and measuring the current of the river San Juan, just below the mouth of the San Carlos, for the purpose of gauging the stream.

Mr. LE BARON'S party had continued the development of the embankments and confining ridge for impounding the waters of the San Francisco and Chanchos, with very satisfactory results. He had, at the time, one party running levels on the ridges of the hills, and the other cross-sectioning the valleys of the San Francisco and Chanchos, preliminary to the location of the sailing line through the proposed basin. This work has been carried out somewhat more in detail than would have been required for the purpose of the present surveys; but I thought that, under the circumstances, no unknown quantity should be allowed to remain unsolved. Party No. 2 has completed the final location from the Saltos de Elvira to Lock No. 2 (survey of 1885), in the valley of the Deseado, and Party No. 1 was making good progress in the location from the latter point to the San Juanillo, towards Greytown (completed about June 10). The balance of the route to Greytown had been previously located. Mr. FORD was running the cross-sections and ridge lines for the location of the dam in the valley of the Deseado. Mr. PEARY had visited the locality the week previous, and reported the conditions entirely satisfactory. The boring party had just finished the borings on the lower route and was ready to proceed with the borings of the upper (direct) route from the San Juanillo to the valley of the San Francisco. On the following day I ordered tracings to be prepared for the company, showing as near as possible the location of the two routes, and Mr. PEARY took charge of this work at once. [These maps we shall shortly give.—ED.] Cross sections of all the embankments needed at the level of the swamps or valleys, from the eastern abutment to connect with the ridge extending from Ochoa to the western limit of the swamps west of the San Francisco, had been completed, and assistants were at the time engaged in running the levels on the top of the hills, following as nearly as possible on the ridge line, and in leveling cross sections on the sailing line in the valleys of the Chanchos and San Francisco. It has been fully determined that the total amount of embankments at the valley or swamp level will not exceed 4,362 ft., divided into ten different embankments of variable length, as against 6,550 ft. proposed in 1885. With good foundations and an inexhaustible supply of excellent red clay, perfectly impervious to water, near at hand, the construction of these embankments will involve no engineering difficulties or considerable expense. The lengths of waste weirs proposed are included in the total length of embankments given above. Unfortunately the hills confining the basins do not reach at all points the required height of 6 ft. above the extended summit level; and the depressions must be brought up to that level by means of embankments of various heights and lengths, built on the saddles or tops of the low hills. The levels had not yet been connected throughout the whole length of the ridges, but they were sufficiently advanced to admit of a close estimate of the aggregate lengths and depths of these several embankments. It is estimated that 15,000 ft. will fully cover the total length, and that 15 ft. will be the maximum mean depth. These embankments, resting on solid ground on the tops of hills, and with the best material at hand for their construction, present no difficulties either in building them or in the cost of the work, when taken in connection with the great advantages attained thereby. In fact, it may be stated that the cost of all the embankments proposed will not greatly exceed, if at all, the one embankment proposed in my report of 1886, while the length of canal in excavation has been reduced by at least five miles.

On the following day, Sunday, the 27th, I left headquarters in a canoe, at 4 A. M., and proceeded down the river San Juan, thence down the San Juanillo to Laguna Benard, and through the lake to the Deseado. Ascending the stream I reached the camp of the boring party at 5 P. M. I spent the night here, and proceeded the next morning to Mr. MILLER'S camp. I then continued my journey to Mr. FORD'S camp. He had finished the profile at the site of the Deseado dam, which proves entirely satisfactory, and I ordered him to take some cross-sections at the site of Lock No. 1, and when completed to go to Greytown with his men. Soon after leaving Mr. FORD I found boating in the Deseado rather tedious and slow, and leaving the canoe took the location line in the valley of the Deseado, reaching the lower falls late that evening. On the following morning I continued the examination of the location across the "Divide" to the Saltos de Elvira, and from there proceeded to headquarters, where I arrived at noon on the 30th, much pleased with the result of my trip. The location has been made with extreme care and much skill, especially through the steep hills and narrow gorges of the "Divide".

After this extended examination I came to the conclusion that the work of location would be completed by June 9, and that the boring party would probably reach the San Francisco not later than June 15. All problems affecting the construction of the canal would therefore have been solved by June 10, except the borings on the west side, and the survey of the water shed of the river San Carlos (which enters the San Juan just above the Odesa dam). The importance of the borings is apparent to all, and as to the survey of the San Carlos basin, I regard it as essential in settling the question as to the best disposition that can be made of that river. In the absence of that information I will continue to regard the embankment at the mouth of the river as a part of the project, but I trust that a more satisfactory solution of the problem may be found later on. The work of location on the western division will be completed on the 19th, except some minor details which will take one or two days more of field work.

The accompanying plans will show the route actually located. The topography adjacent to the line has been sketched in, as it would have been impossible at this time to represent it by contour lines, as will be done in the final plans. The levels have not all been connected with the sea level, and the profiles of the route will be sent at a later day. As to the upper direct route, it may be said that it varies but little from that of 1885, except the "divide" cut, which stands, by the final location, 2,000 ft. longer than that of 1885. The lower route as located is shorter than proposed in 1873, but requires much heavier cutting. The locks are located approximately. It is believed that those on the upper route can be reduced to two, of 55 ft. lift each. At any rate, they need not be more than three in number. The plan of the Western division shows the line of actual location and the basin of the Rio Grande with the approximate flooded area. It will be observed that it is proposed to reduce the number of locks in this division to 3, making the total number from sea to sea 5 or 6, if thought more economical later on. The reduced length of canal in excavation as shown in the following statement, will, I hope, be received with delight by the friends of the canal.

Length of Routes from the Atlantic to the Pacific.

LOWER ROUTE [Not in our judgment at all likely to be adopted.—ED.]

Canal in Excavation.	Miles.	
Greytown to Machado Basin	36.91	
Western Division	12.14	
Free Navigation	49.05	
Machado Basin	1.45	
River San Juan	64.54	
Lake Nicaragua	56.50	
Basin Rio Grande, Western Division	4.83	127.32
Total distance Brito to Greytown		176.37

UPPER ROUTE.

Canal in Excavation.	Miles.	
Greytown to Deseado Basin	12.95	
Divide	3.03	
Hills of the San Francisco	.57	
Machado Valley	1.50	
Western Division	12.14	
Free Navigation.	30.19	
Basin of the Deseado	3.40	
Basin of San Francisco	9.04	
Basin of Machado	1.45	
River San Juan	64.54	
Lake Nicaragua	56.50	
Basin of Rio Grande or Tola	4.83	139.76
Total length Greytown to Brito		169.95

The sailing line across the hills west of the San Francisco, 0.57 miles and 1.50 miles has not yet been completed. It is expected that an actual location will show less cutting than proposed by the location of 1885, yet, in the absence of more accurate information the profile of 1885 between the points *A* and *B* on the map have been used for the above statement.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The special train for the Convention at Milwaukee, left New York at 10.30 A. M., June 26th, with a very small party on board. More than 80 had been expected and provided for, but only about 40 were on board when the train started. In consequence of this and the unsociable scattering of the limited number, one of the four cars was taken off, its occupants being transferred to another which was practically empty. A halt of an hour was made at Albany, and dinner taken at the Delavan House. The afternoon ride through the picturesque portion of Central New York was very pleasant, the weather being bright and cool, and after climbing the heavy grade just west of Albany, where a pushing engine helped the train along, some very quick time was made. Supper was taken in the dining car which had been attached at Albany. A few miles beyond Rochester the train was delayed by a bad freight wreck, caused by a broken wheel; the cars were badly broken up and had blocked three of the tracks; the special was backed down to the nearest crossover, and was switched to track No. 1, enabling it to pass the wreck. Later in the evening the train was stopped twice on account of a hot box on the engine truck. In consequence of these delays the Niagara Falls route was abandoned, and the train took a short cut by way of the International Bridge near Buffalo. During the night much of the time lost was made up, 112 miles being run in 119 minutes. The train was hauled from Detroit to Chicago by a powerful engine, which was one of two built by the Schenectady Locomotive Works, for hauling heavy express trains of 12 or 14 cars, on the Michigan Central Railroad. The engine was of the "ten wheel" type, with 66-in. drivers and 19 × 24 in. cylinders. It has a very heavy, massive appearance, and a tender of extra capacity. These engines prove very satisfactory both as to hauling power and speed and easy riding. The straits at Detroit were crossed in the early morning. A stop was made at Battle Creek, where MR. HAWKS, Chief Engineer of the Michigan Central, conducted the party through the new depot in course of construction. This depot was described and illustrated in ENGINEERING NEWS, Sept. 10, 1887. It is of red brick, with red stone base; the interior is being very elaborately fitted up, finished with oak panelling, ornamented ceiling, carved work, etc. The new station at Kalamazoo, however, which is of similar style of architecture, but without the clock tower, has a more pleasing artistic effect. Soon after leaving Kalamazoo a heavy rain storm set in and continued for the remainder of the day, while the temperature became unpleasantly cool. During the morning the passengers were assessed for their shares of the sleeping car rates, and as a larger number had been provided for than had come, those present had to pay an increased amount due to the expenses being divided up among a small party. It was suggested that a good plan in future would be to send in a certain sum beforehand when stating the intention to attend. At Chicago the party went to the Grand Pacific Hotel to dinner, and thence direct to the Union depot the heavy rain preventing any attempt at sight seeing. Quite a number of members joined the party at Chicago, and the train reached Milwaukee in the afternoon, when the party was taken at once to the Plankinton, and it was with considerable pleasure that they gathered around a large fire in the office.

Thursday morning was clear and pleasant, though somewhat cool to the New Yorkers who had been baking at 96° lately. The stated time for calling the meeting to order was 10 A. M.; but it was delayed until 11 A. M. by various arrangements and preparations. The Convention was held in the very handsome and convenient club house of the Woman's Club of Milwaukee, and in the large hall where the meeting was held was hung a banner with the following inspiring words upon it taken from an address made some years ago by Mr. WHITTEMORE: "The high object of our profession is to consider and determine the economic use of time, power and matter." The meeting was called to order by Mr. J. J. R. CROES, Vice President, and Mr. Geo. BENZENBERG, City Engineer of Milwaukee, having been nominated as Chairman by Mr. D. J. WHITTEMORE, and unanimously elected, was escorted to the Chair by Mr. FRANCIS and Mr. COHEN, and after a few appropriate words of welcome, the order of business was proceeded with. After some announcements, including one from the Milwaukee Club, extending the privilege of the club to the members and guests of the Society, the regular reading of papers was proceeded with. The first paper was by MR. CHAS. B. BAUSH, on "Some Facts in Relation to Friction, Waste and Loss of Water in Mains," an abstract of the first part of which appears in this issue.

Mr. BENZENBERG, in opening the discussion as to the waste of water part of the paper, alluded to the importance of the subject. In Milwaukee a number of meters were set in the business portion of the city some years ago and materially reduced the consumption, increasing the margin of the pumping plant from 2 per cent. to 38 per cent. Tests were made which showed that there was a night waste of about 70 galls. per inhabitant. Mr. FRANCIS inquired as to the condition of the interior of the pipe of the Hoboken works, the friction of the flow of water being an important point. Mr. BRUSH stated that the pipes were new, of cast-iron, with the usual tar coating and in the 5 years of the tests there was no oxidation. In answer to the question whether there had been any loss by pumping wind, as had been found to be the case in Chicago recently, Mr. BRUSH stated that at Hoboken air is pumped into the mains for the purpose of aerating the water, but it is let off by valves at summits and what remains in the water escapes when the water reaches the reservoir. There is no difficulty in this direction. In answer to other questions he stated that he did not think the joints of the pipes were the principal cause of loss; and in the discussion which bore upon this point some singular breaks and leaks were noted. The night waste is tested at Hoboken by opening the gates and ascertaining the velocity of the flow, and then finding the reason of any abnormal velocity. The figures given in the paper referred to domestic consumption only; but the amount used for fire purposes is a very small proportion of the total, averaging 100,000 or 150,000 galls. for putting out an ordinary fire in one building. Mr. BENZENBERG referred to the case of a large fire in Milwaukee, where all the seven steam fire engines were at work for nearly 24 hours; the amount of water used was 10 per cent. of the daily consumption, or about 2,000,000 galls.; the pressure in the district was 45 lbs. He also referred to the use of the Bell waterphone in Milwaukee, for the purpose of detecting leaks. Messrs. WILLIAMSON, CROWELL, GOAD and SMITH also took part in the discussion.

Mr. WHITTEMORE introduced to the Society collectively, Major ROGERS, the discoverer of the pass through the Selkirk mountains, and Mr. J. E. DART. The meeting then adjourned. In the afternoon Mr. J. J. R. CROES exhibited and described a disgram of the daily discharge of a tap for a period of two weeks. The discussion of Mr. BRUSH's paper was also briefly continued.

The next paper, "English Railroad Track", was then read by Mr. E. E. RUSSEL TRATMAN, of the editorial staff of this journal, the subject being illustrated by a number of drawings. The paper is abstracted more fully elsewhere. The conclusions arrived at by the writer were; (1) that the English type of track is very safe and substantial but is unnecessarily heavy and expensive; (2) that the unfavorable opinions in England as to the flange rails are partly due to prejudice and partly to the locomotives and rolling stock being harder on the track than those of the American railroads; (3) that the method of fastening the rails to the ties by bolts, and spacing the ties wide at the middle and close at the joints might well be adopted as improvements on the average American practice; and (4) that with proper types of engines and cars the flange rail, of good design and sufficient weight, with efficient fastenings, would make the best and most economical track. He referred to the folly of introducing a heavy English track into the colonies, which fact is now being recognized and flange rails generally adopted. He also referred to the preservation of timber ties and the use of metal ties, both of which subjects, he thought, deserved more practical attention in this country than has yet been accorded to them. At the conclusion of the paper the meeting adjourned in order to join the ladies, who had been holding a reception during the afternoon. A very pleasant hour was spent by the members and guests in enjoying the hospitality of the ladies of the club.

In the evening a meeting was held, at which, after an opening prayer, speeches of welcome were made by Mr. C. L. COLBY, M. Am. Soc. C. E., of the reception committee, and by the City Attorney, as representatives of the Mayor, who had been called out of town. They were responded to respectively by Mr. JOS. M. WILSON one of the Directors of the Society, and Mr. J. J. R. CROES, Vice-President. The Secretary then read the President's address which was quite lengthy and of which we give an abstract which contains the principal points of interest. The meeting concluded to a vote of condolence with Mr. KEEFER, the President of the Society, in the loss which he has recently sustained.

The address departed somewhat from the usual general character of such addresses by selecting one work of considerable magnitude with which the writer was familiar, and dealing with it in full. The subject chosen was the Canadian Pacific Railway, and was treated at length, and in an interesting manner. Among the points mentioned which distinguish it from other lines, it was stated that no other trans-continental road is so lightly burdened with interest bearing securities; the whole charge upon 2,500 miles of road being $35,000,000 in 5 per cent. mortgage bonds, $14,000 of bonds per mile, or $700 per mile per annum. The history of the events leading directly to the construction of this road was given from the acquirement, in 1867, of the territory of the Hudson Bay Company between the Rocky Mountains and Lake Superior. This carried the dominion of Canada to British Columbia, and in 1871 this latter province entered the Union, thus extending the Dominion to the Pacific ocean. The principal condition of this union was that the Dominion should within 10 years connect the seaboard of British Columbia with the railway system of Canada; construction to be commenced at the Pacific coast in 1873. Work, however, was only commenced in 1875, and then at the Lake Superior end, work at the Pacific not being commenced till 1879, owing, among other reasons, to the destruction by fire of the records of the first three years' surveys. The Canadian parliament had decided in 1872 that the road should be built and operated by a private company, subsidized by the Government, and in that year a contract was made with the late Sir HUGH ALLEN for its construction within 10 years and operation for a similar period, on the basis of $30,000,000 cash and 50,000,000 acres of land. He did not succeed in forming the company, and the road was begun in 1874 as a public work, but in 1880 the government reverted to the original policy of construction by a private company. The terms of the contract with the present company were: $25,000,000 cash and 25,000,000 acres of land; free import of material; the sections under construction by government to be completed and handed over to the company; perpetual exemption from taxation; and no line to be chartered south of the road for 20 years (except for a southwest deviation). The company contracted to build about 2,000 miles of road and to work the entire line for 10 years after completion, the standard to be that of the Union Pacific as it was in 1873. The capital stock was fixed at $100,000,000. There was considerable trouble in raising money by the sale of lands, as government lands were also for sale, and various arrangements for loans were made with the government, but the company suffered

severely from the effect on the market of the crisis in the affairs of the Northern Pacific, which occurred at a time when a bold financial arrangement was about to be made. In 1884 the company had obtained a total loan of $29,880,000, to secure which the government took a lien upon the entire property; while the company had agreed to complete the trans-continental line by May 1, 1886, instead of 1891. Construction at the rate of 500 miles per annum rapidly exhausted this amount, and in 1885 new arrangements had to be effected with the government.

In the early part of 1885 the road was so far completed that a military expedition to the Northwest provinces was sent by it round the north shore of Lake Superior, navigation being closed, and in November, 1885, the last spike was driven in British Columbia on a track laid from ocean to ocean, one piece of which, a section 9 miles long in the Rockies, was a temporary line with a grade of 4½ per cent., double that permitted by the contract. In 1887 the company was freed from its indebtedness to the government and in uncontrolled possession of its property. During the present year the government has found it necessary to obtain the surrender of the company's monopoly as to charters west of Lake Superior. The road is the work of Canada exclusively, without assistance from the Imperial Government, which government, however, has recognized the importance of the line and has united with Canada in subsidizing a line of mail steamers between Vancouver and Hong Kong.

In descending from the watershed of Hudson's Bay to Lake Superior numerous long rock cuts were encountered, separated by marshy bottom valleys with little material for road beds, but as timber was abundant the grade was thrown up, thus reducing the depth of the cuts, and trestling was freely resorted to. This district has the greatest snowfall with the exception of the Selkirk mountain section. Along the Eastern shore of Lake Superior there are heavy rock cuts and numerous tunnels. The highest summit between Montreal and Lake Superior is 1550 feet above tide, or about 95 feet above the lake; and the highest between the lake and Red river is 1590 ft. above tide. The maximum grade between Montreal and the lake is 1 per cent., and minimum curvature 6°. Between the lake and the Rockies the maximum grade going west is 1 per cent. With the exception of a short grade at Medicine Hat; going east the maximum is 40 ft., as far as Winnipeg, and 26 ft. thence to Lake Superior; this last is the section constructed by the government. On this division the line crosses a "muskeg," or bog, which yields about 6 ins. under every train. With a "consolidation" engine hauling 35 cars this track crept 26 ins. in the direction of the train, the rails creeping for about ¾ mile east and ½ mile west of a small bridge at the foot of a grade in both directions. They creep with every train; in warm weather sometimes 12 ins. under an ordinary train. Track bolts break almost daily and repairs are to the extent of a box of bolts per month. Cinder ballast keeps the track to line and surface fairly well, but lining and surfacing are necessary at least once a week. On the passage of a train the "muskeg" shows a series of waves 5 to 6 ins. deep, and the creeping of the rails can be seen. Ties 12 ft. long are to be used here with 40-in. angle bars; a slot being cut in alternate sides of the rail at every tie, as a means of holding the rails in position. During the construction of the western division considerable trouble resulted between contractors and the company as to the meaning of certain clauses defining solid rock and loose rock excavation; there was also trouble over the definitions of "hard pan" or "cemented material", contractors taking advantage of the wording to charge for this instead of for earth.

The line from the Red river to the Rockies was located by the Government to strike Yellow Head pass (Latitude 53°), the government surveys showing that this was the most southern practicable line for maximum grades of 1 per cent. The company, however, decided to follow the 50° parallel as closely as possible, so as to shorten the distance and to leave no room for a competing trunk line further south. On this part of the line is the only section where want of water is experienced; but there is sufficient rain for crops, and surface reservoirs for the railway are proposed.

On the prairie section the line is mostly in embankments to provide against snow blockades. There being only enough gravel for ballasting the wettest portions of the line the roadbed is crowned off and top prairie soil used for surfacing, giving a smooth track for moderately heavy traffic.

Over the Selkirk mountains no trail had been discovered, but as it was very desirable that the line should cross this range many efforts were made to discover a pass, and this was finally effected by Major A. B. ROGERS, M. Am. Soc. C. E. This Selkirk crossing, with a summit 4,300 ft. above tide, penetrating a previously unexplored region is one of the few cases in which the locomotive has preceded the Indian in the formation of any kind of trail. The crossing does not show heavy grading for a mountainous section, but the cost is in the snow sheds to protect the line from snow avalanches and the bridges to give the snow a passage under the railway. The tracklaying was only completed just before the winter of 1885, and no protective works had been built, the line having been built as rapidly as possible; but since then a total of 7 miles of snow-sheds have been built. [The principal types of these snow-sheds have been described and illustrated in ENGINEERING NEWS and we therefore do not abstract that part of the address describing the construction of the sheds.—ED.]. Ventilation openings in the sheds are protected by "split fences", consisting of two walls in the shape of a A, the apex being upward on the hillside, and the outward curving sides deflecting the snow clear of the opening; where heavy slides were expected two of these were built, one higher up protecting the other. Where two or more sheds are in close proximity special precautions are always taken against fire. In the winter of 1886-87, the sheds were subjected to a severe test, with snow 50 ft. deep, weighing 30 lbs. per cu. ft., but they proved strong enough in every respect. The snow-slides are sometimes very rapid and of tremendous force, and at some points avalanches cross the valley and ascend the opposite slope 200 or 300 ft. With ¾ mile more of snow-sheds it is expected that interruption of traffic on the Selkirks in winter will be reduced from days to hours. Mud slides are more troublesome and annoying than snow slides; the slopes of "gumbo" cuts are protected by rows of piles, with gravel filled in between and behind. All the bridging in the mountain section was at first originally of wood, but some of the wooden bridges have already been replaced with steel. The section at the Pacific, built by the government, has Howe truss bridges, with the exception of the Fraser River cantilever. The Stony Creek bridge is 490 ft. long, 172 ft. greatest span, and 294 ft. high, being probably the highest wooden bridge in America; it is to be replaced with a steel arch, and two other high wooden bridges are to be replaced with iron trestles. The metal bridges were designed by the late C. SHALER SMITH, M. Am. Soc. C. E. Where through trusses are unavoidable, there is a width of 20 ft. between centers. A large amount of trestle work has been filled in, but there still remains a large amount east of Lake Superior. The company has to expend the $15,000,000, interest on which is guaranteed by the government for 50 years, in consideration of the abandonment of the monopoly, upon the main line between Quebec and Vancouver; $5,250,000 for rolling stock, $5,500,000 for building, snowsheds, permanent bridges, reducing grades and curves, and other improvements, and $4,250,000 for elevators, sidings, docks, locomotives, steamers, etc. The Selkirk crossing makes the line about 80 miles shorter than it would have been by the river route. The heaviest 100 consecutive miles are where the line descends the Fraser river through the coast range. This section, built by the government, cost about $10,000,000, or $80,000 per mile without rolling stock or stations; there are numerous rock cuts and tunnels and a fine cantilever bridge of 300 ft. span across the Fraser river; this was the second erection of the kind in America and was designed by Mr. C. C. SCHNEIDER, M. Am. Soc. C. E.

The road is well equipped with modern rolling stock. The divisions are about 125 miles long, with shops at alternate divisional points. In the newer country, stations are about 16 miles apart; these have accommodation for two section gangs of 8 men each, a combined freight and passenger station, a 50,000 gallon tank, telegraph office and a supply of track material. There are extensive shops at Montreal and Winnipeg. Coal is used for fuel. On the prairies, water is pumped by windmills.

The Consolidation engines used on the Selkirk division were built at the company's shops at Montreal; they are distinguished by their short stroke, 22 ins.; high boiler pressure, 160 lbs.; and large grate surface to maintain this pressure. They weigh 94½ tons, and have a tractive force of 155.7 per pound pressure on the pistons. They traverse sharp curves with ease. They have the Westinghouse brake on the two forward pairs of drivers, and the American steam brake on the two hind pairs. The water brake is also applied to engines on the mountain divisions. The automatic brake is used in ascending and straight air in descending, with hand brakes manned. The block system, with telephone addition, is extensively used in the mountains. The principal dimensions of these engines are: cylinders, 19x22 ins.; drivers, 4 ft. 3 ins. diameter; rigid wheel base, 14 ft. 3 ins.; total wheel base of engine, 21ft. 3 ins.; weight on drivers, 90,000 lbs.; the tender holds 20,000 lbs. of coal and 30,000 lbs. of water, and the total weight of engine and tender is 180,000 lbs. In winter these engines are furnished with a heavy snow plough, 5 ft. high at the nose and 7½ ft. at the wings, clearing a width of 9 ft. at bottom and 10 ft. at top. The regular snow train has a plough, 16 ft. across wings, and nose 11 ft. above the rail. The freight engines have cylinders 20x26 ins., with 48 in. drivers; weight on drivers, 102,000 lbs. They haul 12 loaded cars up grades of 116 ft. per mile on the Selkirk division. On this division 72 steel rails are used, with 3,500 ties per mile. In consequence of long stretches where supplies can only be obtained by train, each through train carries an emergency box of provisions in the baggage car, in addition to the dining car. At points in the Selkirks where detention by snow slides is possible, provisions, coal and oil are cached every autumn in the way that the early pioneers cached their supplies.

The road has been opened for traffic through 2,500 miles of territory almost uninhabited, and so rapidly that settlement could not keep pace with it. The 1,900 miles of main line built by the company were built in half the contract time, and within the remaining 5 years a subsidiary system of about 2,300 miles has been built or acquired, by which the main transcontinental line has already been made more than self-sustaining.

Considerable space was devoted to the description of the country through which the line passes and the resources which will be developed.

The following are from the condensed balance sheet for Dec. 31, 1887:

Cost of road and branches	$135,689,629.51
Equipment, shops, etc	10,570,932.22
Construction plant	124,702.63
Real estate (at or near Montreal)	283,785.80
Advances and expenditures on leased lines (deducting amount in hand for completing Atlantic & N.W. Ry)	1,800,287.17
Station balances, etc	2,615,323.20
Material and supplies on hand	1,885,535.12
Dom. Govt. guarantee fund	10,310,954.75
Deferred payments	1,252,857.10
Cash in treasury	1,014,802.11
Total	165,548,810.70
Capital stock	65,000,000.00
Mortgage bonds	44,258,019.66
Land grant bonds	3,471,000.00
Current liabilities	7,036,820.69
Interest on Funded Debt and rental of leased lines	1,250,189.06
Cash subsidy paid by Dom. Govt	25,000,000.00
Land grant	18,614,693.64
Town sites	610,487.65
Bonuses from municipalities	307,600.00
Total	165,548,810.70

Swedish Engineers' Club of Philadelphia.—The Swedish engineers, architects, chemists and other technical workers have organized the "Swedish Engineers' Club of Philadelphia," Mr. BACKSTROM was elected President, LEO BERGMARK vice-president, and F. LUDAHL secretary. It is proposed to bring about a union between the New York and Philadelphia clubs.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Pittsburg, Shenango & Lake Erie.—This company has 50,000 cu. yds. of dredging to be done at Conneaut Harbor, Ohio. WYNDHAM C. JONES of Conneaut is Chief Engineer.

Zanesville & Ohio River.—The southern extension of this road is now completed, and regular trains are running between Zanesville and Marietta, on the Ohio river. The line was opened with a special excursion on June 30.

Cresson, Clearfield Co. & New York.—A 3 mile branch is reported to be contemplated to mines on the Laurel river, starting from Dean station.

Cincinnati, Hocking Valley & Huntington.—At the public sale of this road on June 26, the section west of Hillsboro was bought by parties representing E. H. POTTER & Co., of New York. The section between Kingston and Aldelphi was sold to JOHN KARSHNER of Adelphi. For the remaining section no bids were received.

Pennsylvania Company.—The Indianapolis *Journal* discusses the probability of two extensions being undertaken by the company. One is a 67 mile line between the points where the company now uses the Lake Erie & Western on the line between Logansport and Indianapolis. The other extension would run from Bunker Hill, on the Bradford division to Peru, a distance of 16 miles.

Evansville Dummy Line.—A subscription of $60,000 has been voted in aid of this company by the citizens of Evansville, Ind. The Louisville & Nashville R. R. Co., are also to establish repair shops at Evansville.

New York, Mahoning & Western.—The recent application for the appointment of a receiver for this road seems to have grown out of a disagreement with the North Chicago Rolling Mill Co., relative to the purchase of rails. The latter party claim that payment for the rails was not forthcoming from the railroad company, while the railroad managers state that the rails were condemned because of improper length.

Bangor & Piscataquis.—Negotiations are in progress for the controlling interest on this road, held by the city of Bangor, Me. Parties who are interested in the proposed Castine & Bangor wish to purchase it.

Ohio Southern.—Preliminary surveys are in progress for the extension from Jackson to Pomeroy, O., recently reported in these columns.

New Projects and Surveys.

Livermore & Turner.—A railroad is proposed in the Androscoggin Valley in Maine, between these towns. The general sentiment is in favor of a narrow-gauge road. Public meetings have been held at Turner.

Elnora & Richmond.—This company has been chartered in Indiana to build a road from Elnora to Richmond. D. C. GRIFFITHS of Indianapolis is interested.

Williamsport & Binghamton.—It is reported that work on this road will soon be begun. An examination of the proposed line was recently made by some of the leading stockholders. Jos. P. NOYES of Binghamton, is President.

Johnsonburg.—This company has filed a charter in Pennsylvania to build a railroad from Johnsonburg, Elk Co., to a connection with the Buffalo, New York & Philadelphia Railroad in McKean Co., a distance of 18 miles.

Manchester & Portland.—The Manchester, Ct., Business Men's Association have decided to raise $1,000 to pay for a survey of the proposed line.

SOUTHERN

Existing Roads.

Knoxville Southern.—Grading is completed on the first 14 miles from Knoxville south, and the workmen have been transferred to the division between Louisville and Niles Ferry. The location is completed to the Hiawassee river.

Rome.—The Georgia company has agreed to sell the controlling interest on this 20 mile road between Rome and Kingston, Ga., to parties supposed to represent the new Chattanooga, Rome & Columbus, as the purchase would give that company a valuable depot and terminal facilities at Rome.

Nashville & Knoxville.—The tracklayers on this Tennessee road have reached Hickman's Mills. It is intended to complete the line as far east as the Fentress county coal mines this summer. From there it is hardly certain whether the line will be pushed toward Bristol or Knoxville.

Tennessee Midland.—The locating survey is now practically completed from the Tennessee river to Nashville, through the entrance to that city has not yet been determined upon. This part of the work is now in progress under W. A. HAWKINS.

Chesapeake, Ohio & Southwestern.—A reconnoissance is in progress for a line from Paducah to Cairo and right of way is being obtained.

Gulf & Ship Island.—Grading is nearly finished on this Mississippi road between Gulf Port and Hattiesburgh, Miss., a distance of 70 miles.

Monte Sano.—The contract for the construction of this dummy line at Huntsville, Ala., has been let to Owen, Wilson & Co.

Sheffield & Birmingham.—This Alabama railroad company has sued the construction company of the same name for failing to build the company's road in the time specified in the contract, claiming heavy damages.

Orlando & Winter Park.—Tracklaying is in progress on this Florida road.

Oxford & Durham.—It is thought that this North Carolina road will be open for business by Sept. 1.

Blackville, Alston & Newberry.—Tracklaying is still progressing on this South Carolina road and rails are now on hand sufficient to finish the line to the kaolin beds.

Eutawville.—On the extension from Elloree to Sumter of this South Carolina road, tracklaying is in progress, H. T. PEAKE, Vances, S. C., is Chief Engineer.

New Projects and Surveys.

Canaveral & South Florida.—

CANAVERAL, Fla., July 2, 1888.

EDITOR ENGINEERING NEWS—

The above company has been chartered by the State of Florida to build 25 miles of road from Titusville to the Bight of Canaveral as a connecting link between the railroad system of Florida and the numerous lines of ocean steamers running between New York and the ports of Galveston, New Orleans, Brazil and the West Indies. N. N. PENNY is President, W. C. WESSON is Vice President, and HENRY H. HARRISON is Secretary & Treasurer. ROBERT RANSOM, *Chief Engineer.*

Kentucky Midland.—The private and public subscriptions in aid of this company by the city of Frankfort, Ky., and the county of Franklin aggregate $325,000.

St. Cloud Sugar Belt.—This company, whose incorporation was noted last week, is considering the question of building their line from Orlando to St. Cloud instead of from Kissimmee and Runnymede to St. Cloud.

THE NORTHWEST.

Existing Roads.

Minneapolis & St. Louis.—We are sorry to record the fact that the reduced earnings of this road have rendered the appointment of a receiver necessary. The company under President TRUESDALE, whose ability and integrity as a railway manager are universally acknowledged, has made a strenuous effort to keep up with its interest but has found it impossible. Its financial trouble is ascribed to the long and short haul clause of the Inter-State Commerce law; but it is probably true that if its competitors had not been fighting so fiercely among themselves on the rates for through traffic, these rates would have been high enough so that this company might have met them and secured enough traffic to have saved it from its present predicament.

President TRUESDALE has been appointed receiver and a reorganization reducing the interest on the bonded indebtedness to four and five per cent. instead of the present six and seven will probably be effected at an early date.

Chicago, Oquawka & Kansas City.—Apropos of the published statement that Mr. WALTER BROWN of Kansas City has secured $11,000,000 to build this road the *Wall Street News* says:

"We hardly think it possible that this can be true, as we cannot realize that capital is in such straits just now as to subscribe to the bonds of an unbuilt road, which would make the eighth line between Chicago & Kansas City. There are now seven roads in full operation between those points, viz.: Chicago, Burlington and Quincy, Rock Island, St. Paul, Chicago and Alton, Wabash, Chicago, St. Paul and Kansas City, and Chicago, Santa Fé and California (Atchison), and we cannot see the necessity for the eighth, nor can we imagine that capitalists have grown so foolhardy as to be willing to aid in building it."

Duluth, South Shore & Atlantic.—It is now stated that regular trains will not be run to Duluth before September 1.

St. Paul, Minneapolis & Manitoba.—On the Eastern Ry. of Minnesota, track has been laid from Superior to the Nemadji river, 10 miles.

Burlington & Missouri River.—The *Nebraska State Journal* says: "There are very few surveying parties now at work for the railroads of Nebraska. The Burlington has but two companies in the field. One is doing odd jobs around Lincoln, and the other is making observations up in the neighborhood of the Black Hills. The civil engineers and their assistants have plenty of time to talk politics these days."

Winona & Southwestern.—The citizens of Winona have petitioned the company to locate their line along the north shore of Lake Winona, instead of on the south side as planned at present. Another report that the contract has been let for 20 miles of rails and ties is in circulation, but needs confirmation.

Manitoba Central.—Conflicting rumors have been in circulation regarding the construction of the line from Winnipeg to Portage la Prairie. One report says:

"Although it has been repeatedly announced that no arrangement has been made for the construction of this road, it is learned on undoubted authority that a provisional agreement has actually been signed by the Manitoba, Central Pacific and Northern Pacific authorities, and the local Government, whereby the work is to be completed by the first-named company. The road is to be operated by the Northern Pacific in connection with the Red River Valley road. Vice-President OAKES will be here soon to sign the agreement. A check for $5,000 to guarantee that the road will be completed this season has actually been deposited with the Government by the companies interested. G. H. Streval, a well-known contractor, has the contract for the entire 60 miles, and is loading up his outfit to-day. He will proceed to the scene of action to-morrow. The first sod is to be turned Saturday, in Fort Rouge, near the point where the first sod of the Red River Valley road was turned. This is to be the junction of the roads. The engineering staff started out to-day. They proceeded to work at once."

A dispatch to the Montreal *Star* tells a somewhat different story as follow:

"It is evident there is trouble over the building of the Portage link. There is enmity between the Government and the Manitoba Central authorities, and the latter are going on with the construction of the line regardless of the Government, and without any arrangement with them. The contract which Mr. STREVAL got is from the Manitoba Central company. It seems the Government had started surveying a line to the Portage, and the Manitoba Central people got hold of some of the men and instruments, and demoralized the party, so that the survey is now being prosecuted by the Manitoba Central people, and not by the Government. To fortify themselves and make their position as secure as possible, the Manitoba Central have been purchasing the right of way for the road. The company under its act of incorporation can claim from the Government $5,000 per mile under the Railway aid act, but in order to secure aid the work has to be commenced by the first of July. Hence one of the reasons for immediate commencement of the work by the contractor before any arrangement is made with the Government.

"Railway Commissioner MARTIN said to-day that he knew nothing about what the Manitoba Central was doing beyond what he saw in the papers. They had no arrangement or understanding with the Government in any way. They could not even claim the Government aid of $5,000 a mile. The act left it optional with the Government whether or not aid should be granted. He was inclined to give credence to the report that work was being started by them for the purpose of saving their charter. He knew nothing of what they were doing or what their intentions were. The Government was going on quietly making its scheme, which would soon be announced. The road will be built and the interests of he province would be fully protected. The Government would not be bulldozed by any company. They had given no agreement, verbal or otherwise, and whatever would be done would be above board and straight. If the Manitoba Central wanted to build a line to the Portage they could do so, but it would not affect the Government in its scheme."

Chicago, Rock Island & Pacific.—It is rumored in Nebraska that the company has leased a trackage right over the Union Pacific from Beatrice to Lincoln and will build a line from Lincoln to Omaha.

New Projects and Surveys.

Minnesota Northern.—The town of Fulda, Minn., has voted $5,000 to this project. C. H. SMITH, of Worthington, is President.

THE SOUTHWEST.

Existing Roads.

San Antonio & Aransas Pass.—The locating surveys are completed on the Houston extension to the suburbs of the city, and grading is in progress. FRANK LOVETT is the engineer in charge of the extension, with H. L. HOPKINS, J. J. SUTTON and F. W. LOVETT, assistants.—A movement is on foot at Llano to secure an extension of the Aransas Pass system, leaving the main line at Comfort or Fredericksburgh.

New Projects and Surveys.

Kansas City & Bonner Springs.—The location of this suburban road at Kansas City has been completed. The line is about 17 miles in length, and crosses the Union Pacific twice and the Kansas river twice. W. A. SIMPSON is President of the company.

Williamsville, Greenville & Northeastern.—This company has been organized in Missouri to build a railroad from Williamsville to Greenville.

Leavenworth & Denver Short Line.—The Denver *Republican*, reports a rumor that JAY GOULD is to interest himself in the construction of this road projected on the usual slender basis of Kansas railway projects from Leavenworth to Denver and thence "directly to the Pacific coast." President FLETCHER of the Denver Chamber of Commerce, who is interested in the project, is to come East soon to raise funds for the enterprise. The article concludes:

"If JAY GOULD can succeed in securing an interest in the Leavenworth & Denver Short Line, it will in all probability be built under the joint direction of the Chicago, Milwaukee & St. Paul and the Missouri Pacific from Denver to Salt Lake City. At least this is the conclusion among interested parties. If this be the case the Granger branch of the Missouri Pacific will in all probability be built to Denver."

But as there is not the slightest probability of these "ifs" coming true; Denver had better content herself with the ample railroad facilities which she already enjoys.

St. Paul, Alexandria, Jennings Lake Arthur & Gulf.—Chief Engineer KASSON FREEMAN of Jennings, La., has surveyed this Louisiana road from Alexandria, La., to Abbeville. The proposed road opens up a rich and valuable section of country hitherto without railroad facilities.

Montana Kansas & Texas.—Reports of surveys on this road between Albany, Tex., and Coleman induce belief that this enterprise is not yet entirely defunct. Doubtless some north and south line will eventually be built in this region, but it is hardly to be believed that this company can secure capital enough for so great a work.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

DENVER, Col., June 27, 1888.

EDITOR ENGINEERING NEWS:

The air is thick with rumors of work to be done by the various Colorado railroads, but the gist seems to be about this: The D. & R. G. R. R. directors have voted an equipment mortgage of $35 000 per mile, and the President of the road is now in Europe in conference with the foreign bondholders. Home officers profess to have no knowledge of future moves. The new President of the Colorado Midland is curtailing expenses in every possible way and it seems unlikely any aggressive move will be made by that company very soon. The Union Pacific has five locating parties in the field between Denver and Leadville making a location for a standard gauge line, but no move toward construction has yet been made. The general manager of the Denver & Scranton Ry. is now in the East and it is reported that on his return he will let contracts for changing the road to standard gauge and extend it east to the state line. X

Chicago, Rock Island & Pacific.—Carlisle, Price & McGavock have completed the grading on the 12 mile division of the Colorado extension east from Colorado Springs with the exception of one deep cutting, which will not be finished till September. All the divisions east are reported to be practically ready for the rails and the track is being pushed rapidly westward.

Santa Ana, Fairview & Pacific.—Track has been laid on this California road from Santa Ana south to Fairview, a distance of 8 miles. THOS. KILPATRICK was the contractor.

Union Pacific.—The filing of charters for 1,300 miles of branch lines, to be known as the Lincoln & Colorado system, by this company, is we suppose the ground for the following statement in a prominent Eastern daily.

"The Union Pacific is building a new branch to be known as the Lincoln & Colorado branch. It will be 1,300 miles long and embrace seven feeders."

New Projects and Surveys.

Salt Lake Valley & Eastern.—This Utah enterprise is reported to be again showing signs of life. The proposed road is to be an "air line" from Ogden, Utah, to Sioux City, Ia., and the headquarters of the company are at the former point.

Port Townsend Southern.—Surveyors are at work on this proposed line from Port Townsend, W. T., to Portland, Ore.

Marysville, Sutter City & Colusa.—This company has been organized in California and proposes to build a railroad over the route indicated. Most of the right of way has been secured.

Oxaco & Pacific.—The survey of this Mexican road has begun at Tehuacan, State of Puebla. Surveys will be made in the fall from the Pacific ocean to Oxaco. The line is estimated to involve an expenditure of $20,000,000. The concession is held by an English company.

Contracting.

Water Works.—*Hoopeston, Ill.*—The lowest bid for putting in waterworks at Hoopeston is $16,352, from George C. Morgan, of Chicago, and it is expected his bid will be accepted and the water works finished by Aug. 1.

Milford, N. H.—The selectmen of this town have concluded a contract with the Milford Water Works Co. to put in a system of water works, taking the water from Clark's brook, pumping to a stand-pipe on Gilson's Hill, and furnishing not less than 40 hydrants at $35 each per year for ten years. The contract provides that the town may purchase the works at cost and 5 per cent. bonus, with interest, at any time before Dec. 1, 1889, or at appraisal any time within ten years. The works to be completed and in operation by Dec. 1, 1888.

Street-Railway.—The Rapid Transit Company of Denver has let the contract for rails to the Colorado Coal & Iron Co, and they are now being made at Pueblo. Under his contract Mr. DeLappe is to begin grading the road on or before June 25, and have it completed on or before Aug. 5. Work is to begin on the track by July 1, and completed on or before Aug. 15. The contract awarded Halleck & Howard for the ties demands that they shall begin delivering them July 1, and all to be delivered by Aug. 14. The line when completed will cost $300,000.

Buildings.—The contract for the Montana Central buildings at Butte, Montana, has been awarded to A. R. Porter & Bro., who have been connected with the company in the construction of bridges for over two years. The building contract provides for the completion of the work on or before Aug. 1.

Water Pipe.—The following bids were received for water pipe at Columbus, O., June 23, 1888. A. H. McALPINE is the Superintendent:

Name of Bidders.	Size of Pipe.				
	4-in.	6-in.	8-in.	12-in.	16-in.
	pr tn	pr tn	pr tn	pr tn	pr tn
Addyston Pipe & Steel Co	$30.00	$30.00	$30.00	$30.00	$30.00
Lake Shore Foundry.....	30.43	30.43	30.43	30.43	29.93
The Ohio Pipe Co.....	28.00	28.00	28.00	28.00	28.00
Dennis Long & Co.....	30.27	30.27	30.27	30.27	30.27
McNeil Pipe & Foundry Co	29.25	28.52	28.60	27.65	27.65
Shickle, Harrison, Howard	30.00	30.00	30.00	30.00	30.00
R. D. Wood & Co.	30.47	29.86	29.86	29.20	28.75
Approx. amounts required	Tons 60	Tons 1,472	Tons 548	Tons 1,026	Tons 105

The contract was awarded to The Ohio Pipe Co. Columbus, O.

Creosoting Works.—Mr. FRANK WYCKOFF has erected a creosoting plant in connection with his wooden pipe factory at Williamsport, Pa. Mr. WYCKOFF has a contract from the Bell Telephone Company, of Philadelphia, to furnish them wooden casing for underground wires; they will put from 12 to 70 pipes in the same trench and it will take millions of feet for the city of Philadelphia.

The Chicago & Wolf Lake Dock Co., to construct and operate canals, docks, etc., on the Calumet river, Wolf lake, and Lake Michigan has been incorporated in Illinois. Capital, $1,000,000; incorporators, JOHN I. BENNETT, H. M. ALEXANDER, J. E. FULLER, GEORGE DRIGGS, and others.

Reservoir.—The contract for the construction of a new 4,000,000 gall. reservoir for the water-works at Burlington, Vt., has been awarded to Lang, Goodhue & Co., of that place.

Sewers.—*Berea, O.* The bids received were as follows:

Clements Bros., Cleveland, O., $4,147; Campbell Bros., Cleveland, O., $4,660; L. F. Beers, Cleveland, O., $4,721.60; F. Riley & F. Kuntz, Cleveland, O., $5,011.80; C. H. Voute, Toledo, O., $6,189.40; John J. Everson, Akron, O., $4,949. The contract was awarded to Clements Bros.

St. Louis, Mo.—The Board of Public Improvements of St Louis, met June 25, and opened bids for the construction of the Ferry street sewer branch, the primary embankment for the new conduit which will connect the new pumping station at the Chain of Rocks with the present works at Bissell's Point, and an electric plant for the Water-Works to light the buildings, standpipes and grounds. The lowest bid received for the sewer work was that submitted by Edward Rielly, who agreed to complete the sewer for $1,932.12. He was awarded the contract.

Bridges.—*Philadelphia, Pa.*—The common council has passed a bill authorizing the Director of Public Works to have prepared plans and specifications for the erection of a bridge over the Schuylkill at Walnut Street, The estimated cost of such a bridge is $1,000,000.

Crowley, La.—Work has been commenced on the large bridge across the Plaquemine river north of this place. The bridge is 1800 ft. long, and is to be completed in ninety days. J. J. HANNON has the contract.

Waverly, O.—The wooden bridge on the Scioto Valley Railroad that spans the Scioto river at this point, and which will soon be replaced by an iron structure, will be taken down carefully by the railroad authorities and will be offered for sale to the Commissioners of some county. The bridge is a very strong wooden structure of three spans.

Lock House.—The following proposals for completing the No 2. Lock House, Great Kanawha river, were opened at the U. S. Eng. Office, Charleston, W. Va., June 21, 1888: John Gilliland, Charleston, W. Va., $673; Henry Crawford, St, Albans, W. Va., $650; David Eagan Charleston, W. Va., $516. The contract was awarded to David Eagan.

Electric Lighting.—*Ithaca, N. Y.*—The following bids were received for lighting this city: Brush &, Swan Electric Light Co., Ithaca, N. Y., 40 cts. per lamp per night; The Electric Light & Supply Co., New York, 31½ cts. per lamp per night for 3 years, 30 cts. per lamp per night for 5 years; New York & New Jersey Globe Gas Light Co., N. Y., 7¼ cts. per lamp per night for 3 years, 7 cts. per lamp per night for 5 years. The contract will not be awarded until July 11.

Street Work.—*Savannah, Ga.*—The following proposals were opened by the City Council, June 27. For granite curbing: Wakefield Granite Co., Petersburg, Va.; 16-in., 60 cts.; 12-in., 50 cts. G. W. Johnston, Lithonia, Ga.; 16-in. 40 cts.; 12-in., 34 cts. Macon Granite Co., Macon, Ga.; 16-in. 42 cts.; 12-in. 38 cts. J. F. Brand, Lithonia, Ga.; 16 in., 45 cts. Southern Granite Co., Atlanta, Ga.; 16-in., 36 cts.; 12-in. 32 cts. For asphalt pavements: Warren Scharf Asphalt Paving Co., pavment, 6¼ ins. thick, $2.25, National Vulcanite Co., pavement, 7 ins. thick, guaranteed 5 years, $2.35; pavement 8 ins. thick, guaranteed 5 years, $2.35.

Newark, N. J.—The contract for curbing and flagging Morris & Essex Railroad Ave. was awarded to Thos. O'Conner, at the following prices: 20-in. curb, 43 cts.; 4-ft. flagging, 2 ins. thick, 15 cts.; bridging, 40 cts.; corners, $4 per set. Six other bids were received ranging: for 20-in. curbing, from 43 cts. to 50 cts.; 4 ft. flagging, from 15¾ cts. to 19 cts.; bridging, from 30 cts. o 45 cts.; corners, from $4 per set to $6.50 per set.

The contract for grading, curbing and flagging New Jersey Railroad Ave. was also awarded to Thos. O'Connor. Prices, filling, 20 cts.; excavating, 30 cts.; 20 in. curbing, 42 cts.; 4-ft. flagging, 2-ins. thick, 15 cts.; corners, $4 per set. Six other bids ranged as follows: filling, 20 cts. to 50 cts.; excavating, 30 cts. to 40 cts.; curbing, 42 cts. to 49 cts.; flagging, 15¾ to 23 cts.; corners, $4 to $6.50.

John H. Shanley received the contract for paving Clark Street, the prices being $1.85 for square trap rock block paving, and 49 cts. for Belgian bridging. Five other bids, ranged from $1.90 to $2.05 for paving, and from 22 cts. to 58 cts. for bridging.

Brooklyn, N. Y.—The following proposals were publicly opened at the Commissioner's office, June 28, for grading and paving Norman Avenue, from Jewell Street to Moultrie Street with cobblestone pavement: John Hart, per running foot, $4.67; Henry Mogk, per running foot, $4.49.

Buffalo, N. Y.—Bids for grading Bailey Avenue, between Kensington Avenue and the city line, were opened by Street Commissioner Quinn. R. T. Hankin was the lowest bidder at $2,450.

Boston, Mass.—Bids for the paving of Washington Street from Tenth Street to the city limits were as follows: J. L. Flewellen, $2.30 per lin. ft., and 45 cts. per cu. yd. for grading; J. M. Mather, $3.50 and 55 cts.; Griffin & Sterret, $2.60 and 60 cts., respectively. Mr. Flewellen's bid was accepted.

Bridge Contracts.—*Tacoma, W. T.*—The following proposals were opened by the Auditor, EDWARD HIGGINS, June 10: Hoffman & Bates, Portland, Ore., $2,969; California Bridge Co., San Francisco, Cal., $4,120; Pacific Bridge Co., $3,860; San Francisco Bridge Co., $3,900.

The contract was awarded to Hoffmann & Bates for $3,200.

Clarke County, W. T.—The following proposals were opened by the Auditor for three small cheap timber bridges in Clarke Co., W. T., on June 16, 1888: Charles Brown, Hockinson, W. T., Salmon Creek bridge, 106 ft. long, 60 ft. span, $250. Contract awarded. Geo. W. Baker, Battle Ground, W. T., same bridge, $272. F. M. Davis, Salmon Creek bridge, $6 per lin. ft.; Etna Road bridges, $5 per lin. ft. Thomas Wilson, La Center, W. T., 2 bridges, Etna Road, $1.25 per lin. ft. Bents, no spans. Contract awarded. A. F. Davis, Etna, W. T., same bridges and plans, $1.50 per ft.; Victor Flevez, Etna, W. T., Etna bridges 156 ft. long, $190.

Wever, Ia.—The contract for building the iron bridge over the Skunk river has been awarded to Jas. B. Drier & Co., of Keokuk, for $9,435. There will be two 180 ft. spans resting upon concrete piers, supported by piles.

Delaware, Ont.—The Board of Road Directors of the County of Middlesex have let the contracts for building the new iron bridge over the Thames at Delaware as follows: Two stone piers, Isaac Crouse, $8,000 and old timbers; iron superstructure, $5,130, Hamilton Bridge Company; total cost, $13,130.

Centreville, Md.—A contract has been awarded to Capt. Jas. Smith, for $3,250, to build a bridge across the Three Bridge Branch fork of Corsica river to afford a shorter route from Spaniard's Neck to Centreville.

Kansas City, Mo.—The contract for repairing the iron bridge was let to William O'Brien for $1,850, June 28.

Bridges Authorized. At the evening session of the House, Washington, June 20, bills were passed authorizing the construction of the following bridges:

Across the Columbia between Oregon and Washington Territory; across the Mississippi at Wabasha, Minn.; across the Missouri at or near Sioux City; across the Missouri near Ponca, Neb.; across the Mississippi at or near Burlington, Iowa; across the Mississippi at or near Clinton, Iowa; across the Missouri at Forest City, Dak.; across the Mississippi at or near Muscatine, Iowa; across the Missouri in Montana; across the Mississippi near Winona, Minn.; across the Mississippi at Oquawka, Ill.; across the Red River of the North by Duluth, Rainy Lake River & Western Railway company and several others.

Washington, June 27. In the Senate, House bills were reported and placed on the calendar authorizing the construction of railroad bridges across the Oconee river Ga., the Flint river, Ga., the Arkansas river at Fort Smith, the Tennessee at Lamb's Ferry, Ala., the Warrior and Tombigbee rivers, Ala., and the Ocmulgee river in Georgia. House amendments to Senate bills authorizing the construction of bridges across the Ouachita river, Arkansas, the Mississippi river at Muscatine, Ia., the Mississippi river at Ocaquan, Ill., Bayou Terrebonne, Louisiana, and the Mississippi river at Clinton, Ia., were severally concurred in.—The President has approved bills authorizing the construction of the following bridges: June 20, a bridge across the Mississippi river at Hickman, Ky. June 28, a bridge on the Cincinnati & Birmingham Railroad over the Cumberland river, between Burnside, Ky., and Carthage, Tenn., near Tatesville, Ky.

Hartford Bridge Company.—At the last annual meeting the following elections were made:

Directors—THOMAS MARTIN, THEODORE LYMAN, JOHN C. PARSONS (succeeding A. M. GORDON), G. A. WILLIAMS, H. G. BEAUMONT, STEPHEN GOODRICH.

President—JOSEPH MERRIMAM.

Secretary and Treasurer—THOMAS MARTIN.

Auditors—THEODORE LYMAN, STEPHEN GOODRICH.

Water-Works.—The River Point Fire District—an extension of the Pawtucket Valley System, has accepted the proposal of the Pawtucket Valley Water Co. to furnish them with water. It will require 61 hydrants and about 6 miles of pipe. Work will be commenced as soon as the necessary pipe can be obtained. HEBBERT B. BARTON of Centreville, R. I., is Engineer.

Construction Cars.—Messrs. Ryan & McDonald, manufacturers of contractors supplies at Waterloo, N. Y., shipped, July 2, an order for their rotary dumping cars to Guayaquil on the west coast of South America. These construction cars are to be used in railroad building in Ecuador, were ordered on June 28, and specially built for the contractor. This firm are noted for their excellent manufactures, prompt shipments and thorough enterprise.

Electric Lighting.—*Narragansett Pier R. I.*—The Narragansett Electric Light and Power Co., with a capital of $100,000 has been organized to furnish light for the streets, hotels, etc. About 1,200 lights are already in use.

Delavan, Ill.—The Delavan Electric Light Company has been organized, capital $6,000; incorporators, J. M. ALLAN, A. I. MACLAY, and F. E. ALLEN.

Denver Col.—The Denver Electric Illuminating Company has been incorporated, and a desirable location for a plant purchased. The plant has been ordered, and a building will immediately be erected to receive it. The Thompson-Houston system will be used. The $5,000 franchise demanded by the city has been paid, and the new company will soon begin business.

Nantucket, Mass.—A project is on foot to establish an electric light plant in Nantucket, for the summer months. It is proposed to extend the wires to such sections of the town, particularly Brand Point and Cliff, as are not reached by the gas mains, and also to run a line to Siasconset.

Nebraska City, Neb.—The capacity of Nebraska City's electric light plant is loaded down to the last notch, there being fifty arc lights and ten incandescent now in use. These are supplied with the current by two dynamos running in series, driven by an eighty-horse power, automatic cut-off engine,

Proposals Open.

Cleveland Asylum Buildings of Newburgh, O. JOHN TOD, Pres. July 9.

Sewers.—Brooklyn, N. Y. JOHN P. ADAMS, Commissioner, July 10 and July 16.

Dredging.—Hudson River improvement work at Bath Shoal, Kellogg Shoal, Fish House Shoal, Washington Bar, and Van Buren Bar. JAMES SHANAHAN, Albany, N. Y. July 10.

Buildings.—Quarantine Station, North Chandeleur Island, Gulf of Mexico. WILL A. FREBET, Supervising Architect, Washington, D. C. July 10.

Bridge.—Iron bridge over the Passaic River at Avondale, N. J. JACOB KIERSTED, chairman, Franklin, N. J. July 10.

Street Work.—Brooklyn, N. Y. JOHN P. ADAMS, Commissioner. July 11 and 17.

Sewerage.—About 10,000 ft. pipe. H. F. SHELDON, Mayor, Ottawa, Kan. July 11.

Building.—Grammar School building No. 31. WILLIAM H. TOWNLEY, Trustee, N. Y. July 11.

Water-Works.—About 60,000 ft. pipe, 90 hydrants; one impounding, one distributing and one high service reservoir; 2,000,000 galls. pumping engine; brick building. JOHN P. TRUESDALE, Sing Sing, N. Y. July 12.

Boring.—Testing for water on North Brother Island. Com. Pub. Works, 31 Chambers Street, New York City. July 12.

Paving.—Com. Pub. Works, 31 Chambers Street, New York City. July 12

Buildings.—Lodge Lunatic Asylum, Blackwell's Island, Dept. Pub. Charities, N. Y. July 13.

Dredging.—Piers 61 East River. Department of Docks, Pier A, North River, N. Y. July 13.

Sewer—About 9,000 ft. pipe. Funds at present available $60,000. W. H. PHILLIPS, West Bay City, Mich. July 14.

Granite.—For the Congressional Library building. WM. F. VILAS, Com., No. 145 E. Capitol St., Washington, D. C. July 14.

The mographs.—Five Richards Thermographs and 15 self-registering thermometers. A. W. GREELY, Chief Signal Officer, Washington, D. C.: July 17.

Bridge.—Seneca Street, Cleveland, O. About 2,100 cu., yds. masonry, 30,000 lineal ft. piles, 400,000 ft. B. M. oak and pine timber. WALTER P. PRICE, City Civil Engineer Cleveland, O. July 19.

Rain Gauges.—Twenty self recording rain gauges. A. W. GREELY, Chief Signal Officer, Washington, D. C. July 19.

Water-Works.—Ligonier, Ind. The time for receiving bids has been extended from July 6 to July 20. C. F. ELLIS, Trustee, Ligonier, Ind.

Sewers.—About 40,000 ft. pipe and 140 manholes, and other appurtenances for a complete system. W. S. REESE, Mayor, Montgomery, Ala. July 21.

Building.—Extension and completion of the Post Office Building, Brooklyn, N. Y. WILLIAM A. FRERET, Supervising Architect, Washington, D. C. July 23.

Building.—Completion of Branch Penitentiary, Eddyville, Ky. S. B. BUCKNER, Governor, care of MCDONALD Bros., Architects, Louisville, Ky.

WATER.

Liverpool, England.—It seems that the water supply from Vyrnwy was undertaken none too soon, as the existing supply scarcely meets the present demand, so that an order prohibiting the use of fresh water for street sprinkling has been issued. Sea water for watering the streets will be pumped into the new mains. It is reported that 2,000,000 galls. of sea water is already used daily for this purpose and that the quantity will soon be increased. It is also stated that sea water evaporates less quickly than fresh, and forms a crystalline coat over the dust.

Tuscaloosa, Ala.—The government work on the Warrior river above the bridge at this place is progressing satisfactorily. The coffer-dam for the first lock is being sunk and a large force is at work getting out stone at the quarry a mile and a half up the river. The grading of the tramway from the quarry to the stone yard at the first lock is about completed.

Water Note.—

PHENIX, R. I., July 4, 1888.

EDITOR ENGINEERING NEWS:—"The Pawtucket Valley Water Co., of Phenix, R. I. has contracted with the River Point Fire District, to furnish them with water. Six miles of pipe are to be laid."

Water Company Election.—At a recent meeting of the Directors of the Burlington Water Co., Burlington, Ia., Mr. GEO. D. RAND, of Keokuk, was chosen President, to fill vacancy, and Messrs. P. HENRY SMYTHE, JOHN PATTERSON, J. C. MCKELL and CHAS. HOOD were chosen to constitute the Water Board. The company is not yet fully organized, but no changes will probably be made among officers or operatives for some time at least.

Bad Taste of Drinking Water.—Prof. IRA REMSEN, of Johns Hopkins University has stated that his investigations of the drinking water supplied to Baltimore, made in 1881, and subsequently of the drinking water in Boston, demonstrated that the cause of the bad taste and unpleasant odor was due to the growth and decomposition of fresh-water sponge in the artificial or storage lakes. Dr. REMSEN thinks this growth and decomposition were undoubtedly the cause of the trouble in Boston, and he believes they also cause trouble of the same sort in many other places.

Water Famine.—In Denver, Col., a large number of shade trees are said to be dying on account of the failure of the High-Line ditch to supply the water needed.—On account of the bursting of a 36-in. main in Washington, D. C., on June 29, a large part of the city was deprived of its supply of water.

Holyoke, Mass.—The stockholders of the Holyoke water-power company at the last annual meeting elected these directors: JOHN B. STEBBINS, M. D. ROSS, CHARLES M. BEACH, JAMES J. GOODWIN, JOHN L. HOUSTON, J. W. WHEELWRIGHT, HENRY D. HYDE, FRANCIS GOODWIN. The directors re-elected JOHN B. STEBBINS, President, and EDWARD S. WATERS, Clerk and Treasurer. About two-thirds of the stock was represented and the meeting was entirely harmonious.

Lebanon, Mo.—The Lebanon Magnetic Water Co., capital stock $10,000, forwarded articles of incorporation to the Secretary of State on June 21. The Directors for the first year are Hon. ISAAC HOSKINSON, M. W. SERL, CHAS. BANTLEY, J. P. NIXON, D. R. DIFFENDERFFER, D. C. WALLACE and E. R. CLOUGH. The company also completed on the same day a tank to hold 24,000 galls. and a bath house with four tubs. One of the peculiarities of the water is that although the hole is over 1,000 ft. deep, the temperature of the water is from 61° to 62°, or about 5° warmer than water in the ordinary wells and cisterns. That the water is so thoroughly impregnated with magnetism as to transmit it after having been held in a vessel for several days has been thoroughly demonstrated. A piece of iron or steel put in the water soon becomes fully charged.

Water-Works. — ***Massachusetts.*** — Boston. The water board have been authorized to lay water mains to Moon and Long islands, at an expense not exceeding $55,000.——Turners Falls. The water commissioners are much pleased with the new water-works, not a leak or break having yet been discovered.

Rhode Island.—Burrillville. After much agitation the question of water supply and fire protection has been postponed until December next.

Connecticut. — Stonington. Wheeler & Parks, to whom the Mystic Valley Water Co. awarded the contract for building the water-works, have begun work with a large force of Italians. The reservoir is to be circular, 200 ft. in diameter and capable of holding 2,000,000 galls. More than 14 miles of pipe will be required altogether, and the contract for laying it has been sub-let to Mr. Egler. The contract calls for the completion of the entire work before Jan. 1, 1889.

New York.—Sandy Hill. A contract has been made with the Spring Brook Water Co. for the furnishing of the village with an adequate water supply.——Albion. The water-works are being pushed along rapidly, most of the laborers being Italians.

Pennsylvania.—Pittsburg. At a recent meeting the Board of Viewers awarded the Monongahela Water Co. $4,000 damages on account of the opening of Water-Works Alley. Property holders wanted the alley when they thought it was through city property, but on finding that a large sum would have to be paid, they are endeavoring to prevent its being opened.

Illinois.—Lake View. A new pump has been procured for the water-works, manufactured by the Holly Co., Lockport, N. Y., and having a capacity of 12,000,000 galls. per day.——Springfield. Two iron cylindrical "overflows", 8 ft. in diameter have been made by R. F. HAWKINS for use as surplus water escapes for the canal at Windsor Locks.

Michigan.—Lapeer. The new water-works are progressing finely. Of the 9 miles of pipe required all but 2 miles have been laid. The building for the engine and pumping apparatus, a handsome white brick structure, is now complete and ready for the machinery, which is to be put in immediately.

Minnesota.—Winona. The improvements in the water-works building and plant are now nearly completed. The four new boilers are 5 ft. in diameter and 16 ft. long, and two of them are already in use. The new chimney is 5½ ft. in diameter and 95 ft. high.

Wisconsin.—Superior. The Superior Water-Works Company, which recently commenced operations toward the establishment of a plant here, have 100 men at work, and are digging trenches and laying pipes at the rate of 600 ft. per day. The company will soon commence building an engine and pump house, where the power will be furnished to supply both East and West Superior with water from Lake Superior.——Marietta. The business of tapping the water mains proceeds with alacrity. The intake pipe, crossing the river and going out into the bay 1,000 ft. will soon be put in and then the people of the city will have the luxury of pure water from the bottom of the bay at a depth of nearly 40 ft.

Alabama.—Tuscaloosa. Work has been resumed on the water-works, and as all necessary material is now on hand, the system will be pushed to a rapid completion.

Dakota.—Andover. Work has been commenced laying the pipe for the water main from the artesian wells. It will be used for fire protection and a system of water-works.

Narragansett Pier, R. I.—A project is on foot for the construction of water works for this place, as well as the neighboring villages of Wakefield and Peace Dale, which lie about two miles westward from here. The company is known as the Wakefield Water Company, and is organized with a capital of $150,000. The works are to be built by Mr. JAMES GAMBLE, New York, with Mr. J. HERBERT SHEDD, of Providence, R. I., as engineer. It will require thirteen miles of pipe to furnish water to the three places and, with a stand pipe on a high hill near by, a fall of nearly 300 feet will be secured, affording ample pressure in case of fire. This is preliminary to some form of drainage, which will become necessary owing to the rapid growth of the place and increasing number of visitors, and will add materially to the already healthy condition of the Pier. Surveys are being made, and the pipes have been ordered in Philadelphia. Work in laying will be begun on their arrival. It is intended to have a cylindrical tank built on Tower Hill, whence water will be pumped from the Saugatucket river.

Bristol, Mass.—At the annual meeting of the Bristol Water power company held recently the following officers were elected for the year ensuing: President, JOSIAH MINOT; Clerk, IRA A. CHASE; Directors, JOSIAH MINOT, DAVID MASON and BENJAMIN F. PERKINS.

Great Barrington, Mass.—The Housatonic Water Company has been organized for the purpose of supplying that village with pure water. H. J. HANNAGAN of New York is President and O. C. HOUTAILING of Great Barrington is secretary and treasurer.

Ontario.—A water famine threatens Toronto. The consumption per day is about 16,000,000 galls., while the engines pump less than 14,000,000. In London the same thing is feared, and an earnest protest has been made against the use of the lawn sprinklers. The city has an unfailing supply of 2,000,000 galls. which would be adequate if undue waste could be prevented.

Purifying Water.—Among the late English inventions of interest is one by G. BISCHOFF, of London, called a process and apparatus for purifying water. According to the inventor, water is purified by mixing with it iron in a state of fine division, allowing subsidence of the iron and effecting precipitation of a further quantity of the iron by aerating the liquid.

Leavenworth, Kan.—The Board of Health have made a complaint against the quality of water furnished, and have advised the introduction of the Hyatt system of filtering.

Rochester, N. Y.—The following figures furnished by the executive board show the revenue of the water-works department for the last fiscal year, ending March 30, last; Water rents collected, $159,571.79; unpaid water rents, $28,030.69; three cent frontage tax, $8,853.31; amount credited for water for city purposes, $100,000; total revenue, $296,455.79.

Dixon, Ill.—There is trouble between the City and the water-works Superintendent. On the evening of June 16, the supply of water was shut off, leaving the city entirely without fire protection. A special meeting of the City Council was called, and an ordinance passed directing the City Marshall to seize the works, and employ engineers to run them. The Marshall and deputies went to the engine house and took possession, but were unable to start the works on account of the engine having been disabled.

East St. Louis, Ill., Sewerage.—The Supreme Court of the State of Illinois has rendered a decision in regard to the taxes assessed against the St. Louis Bridge & Tunnel Co. for East St. Louis, covering City, County and State taxes for the year 1886, sustaining the decision of the lower courts, that the taxes were legally assessed and must be paid. They amount to about $25,000, which sum the attorney for the Bridge Co. deposited with the County Treasurer of St. Clair, when the company appealed the case. The company objected seriously to paying the sewerage tax for the reason, they claimed, that there was no system of sewerage in East St. Louis. But the citizens of East St. Louis will be surprised to learn that the Supreme Court has decided, on the evidence before it, that the city has a perfect sewerage system which cost in the neighborhood of $30,000, and which can be extended as many miles as desired if the Quarantine Commissioners think it is necessary for the health of the city. An old resident and taxpayer said that as a matter of fact there was no sewerage system in East St. Louis; that about 14 years ago, just before a spring election when JOHN B. BOWMAN was mayor, a gang of about 300 men were placed at work on the streets, and that they laid a pipe sewer from Collinsville Avenue to the creek, at a cost of about $30,000. When the creek was low it partially drained the street it passed through, but when the water rose it entered the sewer and the flood gates were closed. The sewer gradually filled up and only the old-timers had any knowledge of the small pipe sewer, which was of no earthly use. Last spring a pipe sewer was built by the Heims Brewing Co. and the city, at a cost of several thousand dollars. It commences at Heims' brewery, runs west on Illinois Avenue to Fourth Street, then to Davidson Avenue and then to the creek. The high water has also rendered this sewer useless. The flood gate has been closed, and a powerful engine used for the purpose of pumping it out. Residents in the vicinity of Fourth Street and St. Louis and Illinois Avenues, complain bitterly of the stench arising from the overflow of this sewer, which, they say, is a sure breeder of malaria and diphtheria. The heavy rains of the past week, with the streets flooded, proved conclusively that there was no adequate system of sewerage, although heavy taxes are

assessed for that purpose. The Bridge Co., in refusing to pay its taxes, also claimed that the bridge from the pier on Front Street, East St. Louis, was in the State of Missouri. The Court held that the boundary line of the city of East St. Louis and the county of St. Clair, Illinois, was in the center of the river, and re-affirmed the decision of Judge JOHN B. HAY, of the County Court. The tax against the Bridge Co. was levied by the administration, and the Stephens Government have been pushing the collection on the claim that it was legally made, and the Supreme Court holds that it was.—St. Louis *Republican*.

Annual Reports.

St. Louis, Mo.—The report of the Water Commissioner sets forth that the expense of operating and maintaining the works during the year 1887 was $238,700.29; of extension and distribution pipe and mains, $141,000.04, and of extension of the works, $82,662.69, making a total of $462,903.02. The number of gallons of water raised by the low service engines was 1,666,551,000, and by the high service engines 1,152,000,800. The average daily consumption of water for the calendar year of 1887 was 30,457,000 galls., being an increase of 306,000 galls. per day over the consumption for the calendar year of 1886. The demand for an extension of the works has been met by a location for the low service being made at the Chain of Rocks and a connection with the high service system at Bissel's Point through a conduit of 7 miles, and having a diameter of 9 ft. The right of way for the conduit has been purchased, with the exception of a small fraction, which will require condemnation proceedings. At the Chain of Rocks 40 acres of ground have been acquired by purchase, and condemnation proceedings as to the remaining territory required for the station will shortly be instituted. The construction of the conduit should proceed during the present fiscal year under an appropriation from water-works revenue of at least $1,300,000 for the water-works extension. It is probable that $500,000 of this appropriation will cover all the work on the extension of the works that can practically be executed during the year, but the full appropriation is required in order that the work may be placed under contract. The completion of the above plan of extension can be expected by the year 1893, and it will give St. Louis a system of water supply which, if properly extended, will be adequate for the succeeding 100 years. As the unappropriated balance in water works revenue at the beginning of this fiscal year was $766,001.83, there can be no reasonable excuse for not pushing rapidly the plan of removing the low service system to the location decided upon at the Chain of Rocks, and the annual surplus from water works revenue will be adequate for all demands as the work progresses.

Montgomery, Ala.—The City Engineer, W. G. WILLIAMSON, has submitted his report for the year ending April 30, 1888. The amount of construction work was less than usual. Reference is made to the proposed sewerage system, plans for which have been approved by RUDOLPH HERRING, Consulting Engineer. The work done comprised 2,714.43 ft. of surface sewers, 149 ft. of underground sewers, 2,623.28 ft of brick curb wall, 94 ft. of terra cotta pipe, 387 sq. ft. of street crossing and 35 ft. of brick box drain. The staff consists of City Engineer, $150 per month, Assistant City Engineer, $130; leveler and clerk, draughtsmen, two rodmen and two axe and chainmen. Total monthly salary $577.

Evansville, Ind.—Water-Works Trustees have presented their first annual report. During the year a connection has been made with the river, so that a supply can be drawn therefrom for fire purposes. The mains were extended about 2¼ miles, and fire plugs and valves set. Improvements have also been made to the pumps. NOAH A. RIGGS is Clerk of the Board.

Burlington, Vt.—The Water Department's annual report for 1887 shows that during the year 225,111,150 galls. of water were pumped, the average daily consumption being 616,743 galls., which amounts are slightly less than those for 1886. A fire proof fuel shed was erected at a cost of $5,244.29. The number of services added was 101, 84 being ¾-in. and the others ranging up to 4-in. Six services were discontinued. 2,846 ft. of new mains were laid with 4-in. and 6-in. cast-iron pipe. 1577 ft. of cement pipe was replaced by cast-iron pipe. The total length of pipe now in use is 29.58 miles. There are 142 public hydrants and 20 private hydrants now in use. The number of meters was increased 112, making the number now in use 374. A decrease in the amount of water leaving the reservoir at night, which is principally wasted, has been noticed since the increase of the number of meters. The report also contains a summary of statistics suggested by the New England Water-Works Association, rules and regulations for the city of Burlington, etc. F. H. PARKER was Superintendent of Water-Works in 1887.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

AUGUSTA, ME., June 30, 1888.

EDITOR ENGINEERING NEWS.—The Caribou Water Co. proposes to let contracts on or before October 1 for the construction of a system of water-works to supply Caribou, Me., which has a population of 3,500. The supply will be taken from the Aroostook river, and the works will include a wooden dam about 500 ft. long and 12 ft. high, together with a 750,000 gall. reservoir, or the company may provide a 150,000 gall. stand-pipe instead. There will be 7,000 ft. of 8-in. and 6,000 ft. of 6-in. cast-iron pipe, with 25 hydrants. A pump will be needed with a capacity of 1,000,000 galls. in 24 hours, the lift being 180 ft. The town has voted $2,000 a year, for a period of 20 years, for 25 hydrants, and also exemption from taxation. I am looking for a competent engineer to locate dam, reservoir, etc., but will not pay fancy prices. We will contract for the dam separately, if desired. The works must be completed by September, 1889. All our contracts will be guaranteed. F. H. CLERGUE is President of the Company.

H. M. HEATH, *Treas. Caribou Water Co.*

YORK VILLAGE, Me., July 1, 1888.

EDITOR ENGINEERING NEWS:—The York Beach Water-Works Co. has just completed a system of water-works, the construction of which was begun May 1. The works were designed by H. E. EVANS, who is also Superintendent. Water is pumped from artesian wells to a tank of 25,000 galls. capacity, the pump being Worthington duplex, with a daily capacity of 90,000 galls. There are three miles of 4-in. galvanized-iron mains, the services are of the same material, and there are now 100 taps. The works are owned and operated by private parties for the summer business, the estimated summer population being 3,500.

H. E. EVANS, *Superintendent.*

WOLFBORO, N. H., June 28, 1888.

EDITOR ENGINEERING NEWS:—A gravity system of water-works, to cost $40,000, has been projected for this place by the Wolfboro Water Co., of which STEPHEN DURGIN is President, and J. A. FARRINGTON, Engineer. The supply will be taken from Beach pond, and hydrants will be used for fire protection. The population is 3,000.

NEEDHAM, Mass., June 26, 1888.

EDITOR ENGINEERING NEWS:—An act enabling the town to construct water-works was passed by the State Legislature some time since, but it has not yet been accepted by the people. The supply for proposed works is to be taken from springs in the valley of either the Charles river or Rosemary brook, and will probably be pumped to a stand-pipe. The estimated cost of the works is $50,000. Population, 2,700.

E. H. BARNES.

ETNA, Pa., June 25, 1888.

EDITOR ENGINEERING NEWS:—The Etna Water Co. expect to let contracts for their works about July 10, the construction to begin July 15, and the works to be finished Oct. 1. Water will be pumped from the Allegheny river to tanks. The whole system will cost $75,000, cash for which is secured. C. M. HARLOW is Engineer. Population, 3,500.

GEO. A. CHALFAUT.
Prest. Etna Water Co.

LEXINGTON, Va., July 2, 1888.

EDITOR ENGINEERING NEWS:—Our City Council has asked the citizens for a loan of $15,000 to be used in increasing our water supply by piping a large spring, 3½ miles distant, to the reservoir. We expect to begin laying pipe during the first half of August.

J. B. HOLMES, *Superintendent.*

TROY, Ala., June 23, 1888.

EDITOR ENGINEERING NEWS:—Our present works are very small and were erected by the City more as an experiment than otherwise. A franchise to erect a system of water-works has been granted to J. WALKER BATES, 6 Wall St., New York, but operations have not yet begun.

A. C. WORTHY, *City Clerk.*

GALESBURG, Ill., June 25, 1888.

EDITOR ENGINEERING NEWS: The water-works of our city were constructed by a company under a contract with city, excepting some 1½ miles of mains previously put in by city and sold conditionally to said company. By a decree of Judge Gresham in the U. S. District Court the contract is annulled for non-fulfilment on the part of company and title to old mains vested in city. The Fire & Water Committee of our City council is now under instructions of Council to proceed to put in a complete, permanent system of water-works. The city has added ½ mile of mains and secured an excellent supply of water, and are now operating a pumping station and supplying private water takers. By arrangement with the C. B. & Q. R. R. Co., we have good fire pressure when needed. In the present condition of affairs I cannot give such a report as you request, but I shall be glad now and in the future to give you what information I may be able.

CHAS. WASTE, *Chairman Fire & Water Com.*

LE MARS, Ia., June 28, 1888.

EDITOR ENGINEERING NEWS: A private company has proposed to put down driven wells and thus obtain a supply of water for our population of 5,000. J. M. Dunn, a loan broker, is at the head of the scheme. It is expected that work will be begun soon and completed Nov. 15.

P. EAGAN, Jr.

PINE BLUFF, Ark., June 27, 1888.

EDITOR ENGINEERING NEWS:—The Pine Bluff Water & Light Co. begun the construction of water-works to supply this place, June 23, and will finish the works Sept. 1. J. F. THOMPSON is President, and F. L. GREENE, Secretary, of the Company. The franchise is for 30 years, and the hydrant rental $43 each, with 16 to the mile. The supply is taken from a well and river and pumped to a stand-pipe 10 ft. in diameter by 150 ft. high. Direct pressure is also used. There will be 9¼ miles of cast-iron mains. The contractors are: J. A. JONES of Pine Bluff, general contractor. For pumping machinery, the Pond Engineering Co., St. Louis, Mo. For pipes and specials, the South Shore Foundry Co., St. Louis, Mo. For stand-pipe, Palmer & Son, Kansas City, Mo. Eddy valves and Chapman hydrants will be used. The works will cost $170,000, and the company has a capital stock of $200,000. Population, 16,000.

OURAY, Col., June 26 1888.

EDITOR ENGINEERING NEWS:—We shall enlarge our works this year, $20,000 bonds for that purpose having been voted by the city last spring. We want rates on wooden, paper and iron pipes. The present works were constructed in 1881 and consist of two miles of 8 and 10-in. pipe and ten hydrants. (350 taps in 1886) The supply is by gravity from Canon creek. M. H. MAEKIS Mayor.

GEO. C. PIEBUE, *Clerk.*

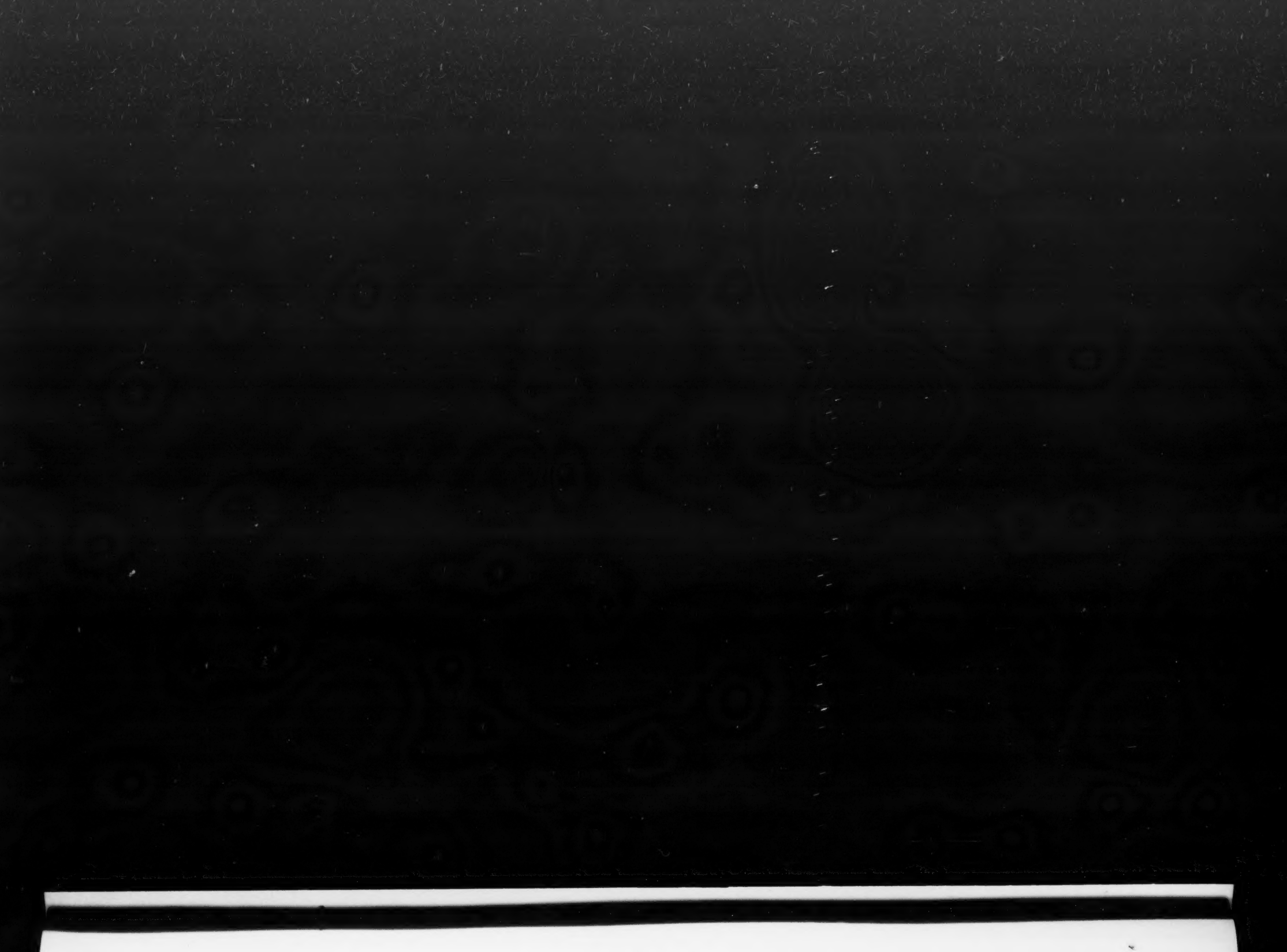
RECORD OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

(CONTINUED FROM PAGE 548).

Sanford Me.—The works were commenced in October, 1887, and commenced operations Dec. 20. at the end of May, 1888, there were 7,695 ft. of mains in operation. The works were built by daily labor under the supervision of E. M. GOODALL. The pumping machinery and tank were supplied by L. H. Wheeler, of Boston; the pipe and specials by R. D; Wood & Co., of Philadelphia; and the valves and hydrants by the Chapman Valve Mfg. Co., of Indian Orchard, Mass. The supply is drawn from springs and pumped either direct or to a tank 24 ft. diameter, 16 ft. deep, 51,800 galls. capacity, by an "Eclipse" pump of the Eclipse Wind Engine Co., Beloit, Wis.; the pump has a daily capacity of 25,000 galls. There are 7,695 ft. of 4 and 6 in. cast iron mains, 112 hydrants and 105 taps. The service pipes are 2 in. and 1½ in.; ¾ in to houses. Average daily consumption 6,000 galls. Ordinary pressure, 15 lbs.; fire pressure, 65 lbs. Cost of works, $10,000; the debt will be $5,000; rate of interest, 6 per cent. The electric light plant cost $5,000. Annual operating expenses, about $50; annual revenue, $832 from consumers, nothing from city, no rent being charged for hydrants. The net receipts from electric lights, after paying operating expenses, was $650. The works are owned by the Sanford Light and Water Co., President and Superintenent E. M. GOODALL; Secretary, E. E. HUSSEY. Capital stock, $10,000 and $5,000 borrowed in notes.

The company was orignally the Sanford Electric Light Co., and after operating as such for about a year, it was decided to put in a water supply, and the company was re-oganized. E. M. GOODALL owns ⅘ of the stock and manages the business. At the end of May there were only 104 consumers, but 75 more were expected to be added this summer. The fire pumps at mills are connected with the mains and are capable of throwing eight 1 in. streams over any building. The stockholders in the company are nearly all property owners and the hydrants were put in by subscription, to protect their own property. The company is putting its earnings into new pipe, etc. instead of paying dividends, and will continue to do so until the village is thoroughly piped. Work is in progess and is expected to be completed in the fall. At present the water is pumped from a large spring by a 20 ft. windmill, and pipe is being laid to another spring which will give a gravity supply. The present population is 1,457.

Lebanon, N. H.—The works were commenced Sept. 1, 1887, and began operations Jan. 3, 1888; they are about completed. They were designed by W. H. LANG, of Burlington, Vt., who was also Constructing Engineer. The works complete were contracted for by W. H. Lang, Goodhue & Co., of Burlington, Vt. The supply is drawn from the Mississquoi river and pumped to a reservoir of 1,000,000 galls. capacity by a W. H. Lang triplex plunger pump of 1,000,000 galls. daily capacity. There are 5 53 miles of mains, 52 hydrants and 80 taps; no meters. The mains are of cast iron; sewers of enameled iron. Ordinary and fire pressure 115 lbs. The cost of the works is estimated at $40,000; debt, $40,000; rate of interest 4½ per cent. The works are owned by the Village Fire Precinct and bonds for $40,000 have been issued. Superintendent, H. P. GOODRICH. Present population 3,000.

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